THE JOURNAL

OF THE

INSTITUTION

OF

PETROLEUM TECHNOLOGISTS

"Conjunctione potiores."

ABSTRACTS

EDITED BY GEORGE SELL, M.Inst.P.T.

VOLUME NINETEEN,

1933.

Published at the Offices of the Institution,
ALDINE HOUSE, BEDFORD STREET,
STRAND, LONDON, W.C.2.

MDCCCCXXXIII.

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ABBREVIATED TITLES USED IN THE ABSTRACTS

Abbreviated Title.	*Journal.*
Aircraft Eng.	Aircraft Engineering.
Analyst	Analyst.
Ann. des Comb. Liq.	Annales de l'office National des Combustibles Liquides.
Ann. Min. Roum.	Annales des Mines de Roumanie.
A.P.I.	American Petroleum Institute.
Asphalt u. Teer	Asphalt und Teer.
Aut. Ind.	Automotive Industries.
Auto. Eng.	Automobile Engineer.
Aviation	Aviation.
Bitumen	Bitumen.
Brenn.-Chem.	Brennstoff-Chemie.
Bull. Amer. Assoc. Petr. Geol.	Bulletin of the American Association of Petroleum Geologists.
Bur. Stand. J. Res.	U.S. Bureau of Standards Journal of Research.
Bur. Mines Bull.	U.S. Bureau of Mines Bulletin.
Bur. Mines Repts. Invest.	U.S. Bureau of Mines Reports of Investigations.
Bur. Mines Tech. Paper	U.S. Bureau of Mines Technical Paper.
Canad. J. Res.	Canadian Journal of Research.
Chem. Age	Chemical Age.
Chem. Markets	Chemical Markets.
Chem. Met. Eng.	Chemical and Metallurgical Engineering.
Chem. Rev.	Chemical Reviews.
Chem. Trade J.	Chemical Trade Journal.
Chem.-Zeit.	Chemiker-Zeitung.
Chemist-Analyst	Chemist-Analyst.
Commer. Stand. Mthly	Commercial Standards Monthly.
Compt. Rend.	Comptes rendus hebdomadaires des Seances de l'Academie des Sciences.
Diesel Power	Diesel Power.
E. P.	English Patent.
Econ. Geol.	Economic Geology.
Eng. News Record	Engineering News Record.
Engineer	Engineer.
Engineering	Engineering.
Erdöl und Teer.	Erdöl und Teer.
Fuel Economist	Fuel Economist.
Gas J.	Gas Journal.
Gas World	Gas World.
Geol. Mag.	Geological Magazine.
Geol. Surv. Canada	Geological Survey of Canada.
Giorn. Chim. Ind. Appl.	Giornale di Chimica Industriale ed Applicata.
Ind. Chem.	Industrial Chemist.
Ind. Eng. Chem.	Industrial and Engineering Chemistry.
India Rubber J.	India Rubber Journal.
Instr. World	Instrument World.

Abbreviated Title.	*Journal.*
J.A.C.S.	Journal of the American Chemical Society.
J. Amer. Petr. Inst.	Journal of the American Petroleum Institute.
J.C.S.	Journal of the Chemical Society.
J. Chem. Soc. Japan	Journal of the Chemical Society of Japan.
J. Fac. Sci. Hokkaido	Journal of the Faculty of Science, Hokkaido Imperial University, Japan.
J. Fuel Soc. Japan.	Journal of the Fuel Society of Japan.
J. Inst. Fuel.	Journal of the Institute of Fuel.
J. Inst. Petr. Techn.	Journal of the Institution of Petroleum Technologists.
J. Phys. Chem.	Journal of Physical Chemistry.
J.S.E.A.	Journal of the Society of Automative Engineers.
J.S.C.I.	Journal of the Society of Chemical Industry.
J. Sci. Instr.	Journal of Scientific Instruments.
Mar. Eng.	Marine Engineer.
Mat. Grasses.	La Matieres Grasses.
Mech. Eng.	Mechanical Engineering.
Mon. Petr. Roumain	Moniteur du Petrole Roumaine.
Nat. Petr. News	National Petroleum News.
Nature.	Nature.
N.Z. Dept. Sci. Ind. Res.	New Zealand Department of Scientific and Industrial Research.
Oil and Colour Trades J.	Oil and Colour Trades Journal.
Oil & Gas J.	Oil & Gas Journal.
Oil Bull.	Oil Bulletin.
Oil News	Oil News.
Oil Weekly	Oil Weekly.
Olii Min.	Olii Minerali.
Petr. Eng.	Petroleum Engineer.
Petr. Times	Petroleum Times.
Petr. World	Petroleum World.
Petr. Z.	Petroleum Zeitschrift.
Rev. Comb. Liq.	Revue de Combustibles Liquides.
Rev. Petr.	La Revue Petrolifere.
Refiner.	Refiner and Natural Gasoline Manufacturer.
Roads and Road Constr.	Roads and Road Construction.
Sed. Petr.	Sedimentary Petrography.
Trans. Faraday Soc.	Transactions of the Faraday Society.
Trans. Petr. Geol. Res. Inst. Leningrad.	Transactions of the Petroleum Geology Research Institute, Leningrad.
U.S. Geol. Surv.	U.S. Geological Survey.
U.S.P.	United States Patent.
World Petr.	World Petroleum.
Z. fur Geophysik	Zeitschrift für Geophysik.

ABSTRACTS.

Class 100. Geographic Occurrence.

1. Survey of Cracking Plants shows Continued Expansion. G. R. Hopkins. *Refiner*, 1932, **11**, 534–536.—An economic survey of cracking plant development in the U.S.A. during the period January, 1931, to January, 1932. The steady decrease in number of units continues, being 1348 in January 1, 1932, as compared with 1868 a year ago. Capacity has increased from 1,950,781 brls. per day to 2,046,981. Texas rank first in total capacity of cracking plants, amounting to 32% of the total. The total capacity of vapour phase plants almost doubled in the two years preceding January 1, 1932, but now only represents 3% of the total. Gasoline yield as derived from an analysis of the reports of 25 large companies is given as 45% of the charging stock. B. C. A.

2. High Grade Fuel Oil from Cracked Residua. R. T. Goodwin. *Refiner*, 1932, **11**, 508–514.—Discussing primarily the U.S.A. market, it is prophesied that the principal demand increment for fuel oils will be for heating purposes. Much of the fuel supplied for this purpose is a distillate product, whereas a stabilised cracked residuum could be used, releasing distillate fuels for preferred services. By utilising the Goodwin Process a stabilised fuel can be produced from cracked residua, before or after blending with a distillate product. The process consists of chemical and mechanical treatment of the residuum, yielding a stabilised fuel oil and a "carbon" suitable for burning as a solid or liquid fuel. Dilute sulphuric acid is added under regulated conditions, whereby solids and unstable hydrocarbons are precipitated and flocculated and may be removed from the oil by gravity settling or filtration. B. C. A.

3. East Texas Field. G. H. L. Kent. *Proc. Nat. Gas. Assoc. Amer.*, May, 1932, p. 43.—The paper describes the opening up of the field and the subsequent measures taken to enforce restricted output. This was eventually reduced from 225 to 67 brls. per well per day, Sundays being excluded.

At present the field, which covers an area of approximately 10,000 acres, contains 5000 producing wells and an estimated increase of 100 wells per week.

East Texas Crude is classified as a paraffin base, high gasoline content (36%) crude with a gravity of 39° to 42° A.P.I.

Geologists are of the opinion that approximately 2 million brls. of oil are yet available in the field, with a probable gas accompaniment of 500 cu. ft. of gas per brl., and a gasoline recovery of 2–5 gal. per cu. ft. S. B.

4. West Texas Ordovician. A. Young. *Oil Weekly*, 5.12.32, **67** (12), 12–13.—The main problem in exploring the Ordovician in West Texas is its extreme depth which is dependent on the variable thickness of the Mississippian-Pennsylvanian formations which overlie it and which in turn are covered by the Permian. These Carboniferous rocks are practically absent at Big Lake, where the Ordovician is so productive, but to the south-west in the Marathon basin they are over 8000 ft. thick. As, however, these sediments appear to thicken towards the south-west, so with the structural rise of the Permian basin to the south does the overlying Permian section grow thinner.

A further problem is the location of the buried structures of the Pre-Cambrian basement, in which the main structural trend of the uplifts appears to be roughly north-west—south-east. Finally, the intense movements which closed the Pennsylvanian period involved the Ordovician locally in intense folding and faulting unfavourable for the retention of oil.

Recent Ordovician tests in West Texas have discovered oil shows in the Ellenburger lime in two localities, on the Edward's plateau in Kerr County and in Fisher County, where the well was drilled on the flank of a Permian structure. With regard to Big Lake, 15 wells now produce from the Ellenburger, which has been penetrated to a depth of 500 ft. C. E. H.

5. Lower Balcones Fault Crevices Profitable. G. R. Pinkley and E. S. Post. *Oil Weekly*, 10.10.32. **67** (4), 26–29,—Ever since the discovery of the Luling field in 1922 much prospecting has been done for Edward's lime oil in Guadalupe and Caldwell Counties, Texas, and has resulted in the discovery of the major fields of Salt Flat and Darst Creek, together with a number of smaller prospects. The chances of obtaining large production from crevices in the Cretaceous limestones in this area has recently renewed activity and resulted in the discovery of three new producing areas in the last year.

This area lies on the rim of the Gulf Coast basin, the rocks dipping gently to the south-east. The outcropping Eocene rocks overlie the Cretaceous, which in turn rests on Pre-Cambrian. The vast majority of the wells drilled test the Edward's lime as the main producing horizon, but many crevice wells have produced from the Austin chalk. Structurally the area is marked by a series of parallel north-east—south-west faults with a general downthrow to the north-west. When a fault block if folded there is usually oil accumulation, but fields of any importance are only found in areas where the structural features are of major proportions. C. E. H.

6. Jackson Gas Field Hinds and Rankin Counties Mississippi. W. H. Monroe. *U.S. Geol. Surv. Bull.*, 831–A.—The Jackson gas field is situated in Hinds and Rankin Counties Mississippi, in the eastern Gulf Coastal Plain. Production comes from a Cretaceous chalk overlain by a regular sequence of Tertiary rocks. The oldest rocks outcropping on the crest of the anticline at Jackson belong to the Cockfield formation of the Claiborne group, and these are overlain by the Jackson formation followed by Pliocene and Quaternary deposits. Structurally the field consists of three geologically high producing areas entirely unconnected and unsymmetrical, the area to the east in Rankin County being the most productive but not the highest structurally. No oil in commercial quantities has so far been produced although several wells have yielded traces. C. E. H.

7. Petroleum Refining in Patagonia. W. H. Dennis. *Ind. Chem.*, 1932, **8**, 281–282.—A general description of procedure is given. The crude has a gravity of 0·930–0·950, contains about 25% water and a sulphur content 0·3%. Water is removed by a high potential alternating current, which causes coalescence of the former. The crude is then topped, to remove petrol and kerosine, and subjected to distillation in Kellogg Stills, the products being gas oil, stock for the cracking units and fuel oil. Cracking of the gas oil is effected by the Cross process and products are coke, fuel oil, petrol and gas. R. E. D.

8. Oil and Gas Possibilities of France. F. G. Clapp. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1092–1143.—The Pechelbronn field, in Eastern Alsace, is both the oldest and the principal oil producer of France, having been exploited for over a century, with a total production (up to 1931) of 1,720,209 metric tons. The oil occurs in lenticular sands in Oligocene strata, whence it is recovered both by a system of mining by shafts and galleries, and by means of wells.

Next in importance is the Gabian field, in the Lower Languedoc basin, where a number of wells drilled in 1924 encountered commercial quantities of oil in the Lower Triassic sandstone, yielding a total production to date

of 19 038 metric tons. The Limagne graben (Auverne) has extensive bitumen deposits mainly occurring in Oligocene sediments surrounding volcanic necks but only a few barrels of oil have been obtained by test wells. Further bitumen impregnated sandstones and limestones of Eocene, Cretaceous and Jurassic age are encountered in the Jura mountain region, where they are extensively worked along the valley of the Valserine River, as far as Val Travers in Switzerland. Wells drilled in the vicinity of Vaux-Fevroux have tapped a good supply of natural gas in the Keuper series of the Triassic of this area, and this is still utilised locally.

Of the remaining sedimentary basins of France, a great diversity of suitable formations and structures exist in Aquitain, together with numerous surface indications, but owing to complex tectonics, detailed geological and geophysical study will be essential for exploration. The gas seepages of the Saône-Rhône valley, and the mild anticlines of the Paris basin also await investigation. Although it seems unlikely that France will ever become a great oil-producing country, some profitable fields may ultimately be discovered. A. L. G.

9. Occurrence and Production of Petroleum in Germany. W. A. J. M. Van Waterschoot Van Der Gracht. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1144–1151.—In Germany, commercial production of petroleum is from two main districts. The first is the North German plain, in the Hercynian foreland. Here, salt-plugs from the Permian salt formation have pierced the overlying Mesozoic and Tertiary sediments, and it is exclusively in the peripheral zone of some of these that the fields are situated. The second petroliferous district is the intramontane Permian salt basin of Thuringia, where a highly productive dolomite was accidentally discovered below the salt formation in the course of potash mining. The new discovery is expected to increase German oil production by about 80%. The estimated production during 1931 was 1,600,000 brls. A. L. G.

10. Geology and Mining of Petroleum in Poland. K. Bohdanowicz. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1061–1091.—Owing to the occurrence of abundant oil deposits on the flanks of saline plugs, salt anticlines, and some diapir folds in Rumania, there was at one time a tendency amongst geologists to regard occurrences of diapir structure as favourable locations for oil prospecting. It is now recognised, however, that such highly complicated and compressed structures are of secondary importance to more simple forms. An illustration is furnished by the Caucasus area, where diapir structures are either barren of oil deposits, or yield a production inferior to other adjacent types.

In the Polish Carpathians the folding is intense, and is further complicated by a great series of shears, imbricates, and thrusts, especially in the marginal zone along the sub-Carpathian depression, and the south-west border of the Median group. The latter area also displays a series of narrow folds arranged "en échelon"; an alignment arising from their formation in two separate orogenic phases. The oil-bearing series, of Cretaceous, Eocene, and Oligocene age, were first subjected to gentle folding, giving rise to primary accumulation in the structural highs so formed; then, in Middle Miocene times, a second severe orogenic phase highly accentuated previous folds and developed a great system of shears, thrusts, overturned folds and diapirs. In many cases these changes resulted in the loss of original oil accumulations, but in others, a mass of overthrust sediments served as a protective covering.

The present decline in Polish production is attributed to the fact that the most productive fields are those which have been exploited for the longest period, while they have not been found capable of extension. Drilling is

now in progress, with the object of testing the Lower Miocene of the sub-Carpathian province, and an extension of the great thrust of Boryslaw in the Marginal zone; in the Median zone there is a possibility of further discoveries in deeper Cretaceous horizons. A. L. G.

11. Liangri Oilfield, Sakhalin Island. N. A. Gedroitz. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932. Series A, Paper 10. The Liangri area is situated near the north-west coast of Sakhalin Island. The Tertiary beds exposed in this area consist of alternating sands and clays with brown coal seams which are gently folded into two parallel north-south anticlines. Owing to the lack of palæontological evidence the exact age of these rocks is in doubt, but they appear to be younger than the oil-bearing deposits of eastern Sakhalin and are probably of late Tertiary age. Oil seepages occur in the lower sandy series on the west flank of the eastern anticline. C. E. H.

12. Geological Explorations in the Kabristan Area. S. E. Pakhomov. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932. Series A. Paper 18.—The Tertiary rocks exposed in this area range from the Akchaghylian stage down to the upper Kown series, which lies below the Maikop series. These beds are folded into two east-west anticlines known as the Akhtarma and Cheildag structures. A great number of small mud volcanoes occur along the axial regions of these folds and give rise to the large flows of clay and brecciated material which cover the area. Oil shows occur in the Diatomaceous beds, the Spiralis beds and the upper part of the Maikop series, but the future possibilities of the area at present remain in doubt. C. E. H.

13. Geology of the Zelenski and Kostenkov Mountains. N. B. Vassoyevitch. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932. Series A, Paper 19.—These mountains are situated in the southern part of the Taman Peninsula near the coast of the Black Sea. Structurally the area consists of two north-east—south-west anticlines lying in echelon, both being overturned to the south-east. The northern or Mt. Zelenski structure runs out to sea, excellent sections being exposed on the coast.

The formations exposed range from the Maikop beds of the Lower Miocene and Oligocene, which are exposed in the cores of both anticlines, up to the Nadrudni beds of Upper Cimmerian age, oil indications being observed in the Middle Miocene beds. The Maikop beds are generally considered to be the primary oil bearing series in the area, but the general scarcity of secondary oil in the younger beds in Taman, in spite of their similarity to the productive series of the Apsheron Peninsula, is due partly to lack of a suitable impervious cover and partly to the intense denudation of the folds. C. E. H.

14. Geology of Tsybanova Balka. A. Fedorov. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932. Series B, Paper 4.—This area is situated near Anapa, on the Black Sea. Tertiary beds ranging from the Foraminiferal beds of the Eocene up to the Nadrudnij beds of the Pliocene are involved in a gentle east-west anticline pitching to the west. Oil seepages in the area are found in the Lower Sarmatian and in the Foraminiferal beds. The presence of oil in the Chokrak-Spirialis, Maikop, and Foraminiferal beds is considered possible. C. E. H.

15. Scheme of Exploitation of the S. Daghestan Gas Bearing Strata. I. Brod. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932. Series B, Paper 8.—In order to increase gas production in South Daghestan to supply various new industrial undertakings it has been decided to develop the three gas fields of Daghestan-Ogny, Duzlack and Hosh-Menzil. These three areas are domes

on a long north-west—south-east anticline running parallel to the coast of the Caspian Sea. Gas production is obtained from the clayey series of the Maikop beds of Oligocene age in all three areas, but at Hosh-Menzil gas also occurs in the upper Chokrak-Spirialis beds. Elaborate schemes for the rational development of these fields are described in detail. C. E. H.

16. Zone of Tertiary Deposits of Southern Abhasia. S. Ilyin. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932. Series B, Paper 17.—The Tertiary rocks in this region range from the Eocene to the Pliocene. The Nummulitic limestones and marls of the Eocene are followed by the bituminous clays of the Maikop series, and these again are overlain by the variable Chokrak, Caragan and Konka beds of the Miocene. The uppermost division of the argillaceous Sarmatian series was eroded by the transgression of the Maeotic sea, the deposits of which are widespread over the area. Another break in the sedimentation appears to have existed in Pliocene times before the deposition of the Pontian. Orogenic movements before the Maeotic transgression have resulted in the underlying Tertiaries being folded into structures favourable for oil accumulation. C. E. H.

17. Geology of the Izber-Bash Region and Kayakent Oilfield. I. O. Brod, W. A. Znamensky, N. N. Rostovzev. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932. Series B, Paper 25.—It has recently been established that the Izber-Bash structure is but another uplift on the northern extension of the main eastern productive anticline of S. Daghestan on the northern end of which the Kayakent uplift is situated. The main axis of the anticline runs north-west—south-east parallel to the coast of the Caspian Sea, and both the Izber-Bash and Kayakent structures appear to be assymetrical anticlines downfaulted along their south-western flanks.

It is claimed that the Second Mediterranean Stage, layers of which are productive at Kayakent, should prove more productive at Izber-Bash on account of the increasing sandiness of these layers towards the north. C. E. H.

18. Geological Explorations in the Region of the Paromai Kydylania Rivers, Sakhalin Island. A. V. Shcherbakov. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932. Series B, Paper 31.—This area, situated on the east coast of Sakhalin Island, is marked by an assymetrical north-south anticline with a steep western limb complicated by considerable strike and dip faulting. The Upper Tertiary deposits exposed range from the Supra-Nutovo to the upper Okobykai series, and oil seepages are confined to the lower Ekhabi and upper Okobykai series on the eastern flank of the fold. Two oil bearing horizons are supposed to exist in this region. C. E. H.

19. Search for Oil in Parma District, Western Italy. M. Anelli and A. Belluigi. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1152–1159.—The Parma district, and the foothills of the Northern Appenines, present a number of difficult geological problems. With the exception of the Pliocene system, the stratigraphy of the region is exceedingly controversial, and the tectonics are complex. In the foothills a double system of folding exists, one parallel series trending north-west—south-east and a second at right angles. The Po Valley is almost entirely covered by thick Quaternary alluvium, but geophysical investigations show the existence of a series of folds in the buried Pliocene whose trend corresponds closely to that of the foothills. Oil indications are found to correspond in distribution with these structural highs, and geophysical results received further confirmation from test wells provin the existence of suspected diapir structure. A. L. G.

See also **Abstracts Nos. 33, 59 and 105.**

Class 200. Geology and Origin.

20. Observations on the Study of an Oilfield. J. W. Weil. *J. Inst. Petr. Techn.*, 1932, **18**, 881–897.—A short lecture with discussion on the geological investigation of an oilfield and the practical interpretation of the results obtained. G. R. N.

21. Asymmetry of Sound Velocity on Stratified Formations. B. McCollum and F. A. Snell. *Physics*, 1932, **2**, 174.—In seismic prospecting the recorded apparent velocities are dependent whether the wave is being propagated upalope or downslope. By measuring the asymmetry of the velocities the slope of the high velocity bed can be determined. Outside the above cause, velocity asymetry is often due to the effect of the bedding planes, dipping with respect to the surface, and not to a sloping subsurface. It was found that sound waves travel faster parallel to the bedding planes than perpendicular to them. Following values were observed on some exposures of the Lorraine Shales of Quebec: velocity parallel to bedding planes, 4450 m/sec., velocity normal to bedding planes, 3205 m/sec.

On the above facts is founded the developing of a new seismic method, the so-called "dip shooting" (this should be distinguished from the "slope shooting"). The method gives a structural rather than a topographical profile. It is obvious that in case of an eroded and buried land surface the ordinary refraction method merely records the topography. Shale areas which have been folded and subsequently levelled may be covered with just sufficient alluvium to make pitting difficult and expensive, while the seismic "dip method" can easily profile the structure. The presence of considerable thickness of overburden does not interfere with the use of this method. O. W.

22. Some Aspects of Electrical Prospecting Applied in Locating Oil Structures. L. J. Peters and J. Bardeen. *Physics*, 1932, **2**, 103.—The three electrical constants whose variation may be determined are the resistivity, the magnetic permeability and the dielectric constant. In the study of oil structures the resistivities encountered vary from 100 to 10^{17} ohms-cm. The dielectric constants of earth materials have values ranging from 1 to 10. The variation of magnetic permeability is negligible.

An ideal system of prospecting for oil would be one which directly indicates the presence of oil, but such attempts have met with little or no success. The basic assumption in mapping geological structures by electrical methods is that the changes of resistivity follow the bedding planes. Beds which have large resistivity contrast are used as marker beds. Such a bed must be in conformity with the bed carrying the oil. In case of major unconformities it is necessary to follow a marker bed below the unconformity. In connection with this the depth limitation has to be considered. Up to the present time the depth at which structures have been reliably mapped by electrical methods has not exceeded 1500 ft.

Electrical methods of geophysical exploration may be divided into two classes: (1) direct current methods, and (2) alternating current methods. In the direct current methods current is passed in to the earth by means of two electrodes on the surface. The potential on the surface of the earth is then called the normal potential. Any changes of resistivity in the subsurface beds alter this normal potential. Thus measurements of potential on the surface give an indication of these changes of resistivity. The interpretation of the methods is partly only qualitative and as regards depth only approximative. These approximations become worse and worse as the number of strata become greater. A rigorous solution is theoretically

possible by using the theory of images. However, these solutions are cumbersome to handle when the number of layers are more than two.

Electromagnetic methods depend on the induction of currents in the earth by means of a primary current on the surface. The quantities which may be measured are the magnitude and phase of the components of the electric and magnetic vectors on the surface of the earth. There are two simple primary cases for which the theoretical problems have been solved; the field of a circular coil and the field of a long horizontal wire. Most electromagnetic methods have been made use of on one of these. High frequency waves are very highly damped by the surface layers, and are not important in oil prospecting. At the lower frequencies the conductivity governs the distribution of current in the earth. Methods of locating oil directly by means of its dielectric constant have no chance.

Experience has shown that often good marker beds can be found at shallow depth. However, where shallow sediments have been deposited in form of lenses, these are not continuous enough to give a structure picture. On monoclinal beds where the successive beds are outcropping, the lateral variation of the conductivity of the surface material makes the interpretation impossible. O. W.

23. Geologic Possibilities of the Resistivity and Magnetic Prospecting Methods. C. A. Heiland. *Terrestrial Magnetism*, 1932. **37**, 343–350.—The purpose of the article is to describe a number of the more recent geological applications of the magnetic and electrical resistivity methods.

Results of some recent magnetic observations are described, which demonstrate that gold can not only be located in placers when associated with magnetite, but also *in situ* if it occurs in magnetite-bearing contact-metamorphic rocks.

The usefulness of the magnetometer in reconnaissance mapping of oil structures associated with uplifts of the crystalline basement rocks has been demonstrated in numerous oilfields throughout the United States. An example is given showing the agreement between magnetic and structural contours.

Resistivity methods are used successfully in engineering geology to outline zones of weakness and to determine depths to bedrock under cover. A number of results obtained in this work are demonstrated.

Finally, progress has been made in the application of resistivity methods to the location of groundwater. A number of typical curves and their interpretation are discussed. G. S.

24. Preliminary Note on a New Magnetometer. C. A. Heiland. *Physics*, 1932, **3**, 18–22.—Decribes a vertical magnetometer which does not require a tripod and levels itself. The orienting compass remains attached to the instrument. The magnetic system is suspended in jewels and the magnetic vertical intensity is balanced by the torsion of a helical spring. The magnetic system is adjusted to the normal intensity by setting the spring and the anomaly is roughly proportional to the angle of deflection from the horizontal. G. S.

25. Effect of Heat Treatment on Fine Metallic Suspensions. N. N. Zirbel. *Physics*, 1932, **2**, 134.—Observations have been made on several tungsten and platinum-irridium wires of diameters and lengths suitable for torsion balance use. The wires were heated in a brass tube wound with an electrical heating coil and insulated with asbestos. A glass window allowed the angular position of the suspended system to be observed. To reach temperatures above 500° C., the wire was suspended in a glass tube with a weight of 6–10 grams at the lower end dipping in a copper sulphate solution so that a

current could be passed through the wire. The effects of convection currents were eliminated from the observations.

By heating the wires the drift (untwisting) of the wire is reduced. The time required for such treatment is decreasing with higher temperatures. If a wire from which the time drift had been removed by the above process were strained beyond the elastic limit by a longitudinal stress, then the time drift of the wire will show up again.

The effect of the heating on the temperature coefficient is remarkable. Starting from lower temperatures the temperature coefficient decreases with the increase of the temperature, until the coefficient becomes zero at a critical temperature. By heating above this temperature, the coefficient increases again and has an opposite sign. After the wire has once been heated to a certain temperature, subsequent heating at lower temperatures has no effect.

O. W.

Class 300. Development and Production.

26. Rotary with Air Operated Controls and V-type Engines. K. C. Sclater. *Petr. Eng.*, October, 1932, **4** (1), 36.—The layout on a well in Lincoln County, Oklahoma, is of especial interest. The power for this rotary drilling unit is supplied by four 250 h.p. Le Roi V-type cylinder engines, operating with either gasoline or natural gas. Two engines are for the drawworks and two for the mud pumps.

The drawworks engines are equipped with air compressors for operating self starters that are controlled from the driller's position on the derrick floor. There are also air operated controls on the reversible reduction gears. Twin disc clutches complete the air operated control equipment.

Through a 2-speed gear box, power is transmitted, by means of a high speed roller chain drive, to the power slush pumps. The pinion shafts of the mud pump are connected direct to the driveshaft of the gearbox by means of flexible couplings designed so that either pump can be disconnected merely by removing the chain that encircles the sprocket like halves of the coupling.

L. V. W. C.

27. Sub-Surface Economics in Drilling. B. Barkis and R. D. Copley. *Oil Weekly*, 21.11.32, **67** (10), 24.—Economies in casing may be made in a variety of ways. The quantity may be reduced in the producing zones by the use of combination oil and water strings or by the use of combination liners. By improved drilling technique the clearances between casings may be reduced. A combination of weights and grades of casing and a standardisation of casing sizes will also reduce expense.

The improvement in the quality and manufacture of drill pipe and the development of straight hole practice has increased the life of this pipe. In the deeper holes, however, where small pipe is used, pump pressures have greatly increased. As a result the cutting action of the fluids through the tool joints has increased, and it may be necessary to redesign these joints in order to reduce the pump pressures and increase the life of the smaller size pipes. A reduction in the size of the hole drilled will effect economies, since less material will have to be removed, and this is a better index of the actual work accomplished than the average daily footage.

The improvements made in the hard facing materials has increased the amount of time the bit may remain in the bottom and has thus lowered the drilling costs. Reclamation of drilling mud and the removal of abrasive material in the mud have also reduced costs. An increase in the number

of successful cement jobs is due to the improvement in technique, whilst the improvements in surface equipment have assisted in speeding up the handling of casing and the placing of the cement. Straight hole practice has decreased the possibility of plugging back and re-drilling and has thereby reduced the necessary drilling time. Economies in casing have been effected and future economies may be developed through taking fewer cores. Formation testers and electrical resistivity methods have also assisted in reducing costs. L. V. W. C.

28. Preparing Formations for Production. W. A. Sawdon. *Petr. Eng.*, Nov., 1932, **4** (2), 51.—The sealing effects of mud on productive formations has recently received considerable attention, and the problem of eliminating any adverse action such sealing may have on both the initial and ultimate production of the well will probably be given equal attention.

The object of using rotary mud is to keep the hole in a good condition by depositing a sheath of mud on the walls. If means are available for removing this layer of mud, which encases the sand, the major objection to the use of rotary is removed.

Most of the fluid which penetrates the producing zone is the water which filters into the sand before the face is plastered with the solid particles. With well controlled mud this infiltration can be kept down to a negligible amount.

A mud which will quickly seal the walls will overcome, in the majority of cases, the harmful effects of rotary mud on the producing zones, and then by removing this sheath the well can be placed on production in a good condition.

A sheath of mud must be formed quickly and, providing the drilling mud possesses high viscosity, high concentration of colloidal material and low sand content, a thick sheath will not only be unnecessary but undesirable.

Scraping of the sand appears to be the most effective method of removing the mud solids. One method is to drill the entire depth with mud as the circulating fluid, and then to replace the mud by oil. The face of the sand is then scraped with a rotary hydraulic expansion wall scraper, using the oil for circulation.

In high pressure zones where the oil cannot be used with a degree of safety it is necessary to install rotating blow-out preventers and a flow bean on the outside of the casing to restrict or completely shut off the flow. As the oil becomes light and gassy it is changed with cold gas-free oil.

This rotary hydraulic expansion wall scraper gives a wide range of diameters and may be used to enlarge the hole opposite the producing zone in addition to the scraping operation. L. V. W. C.

29. Determining Flow Strings. W. C. Edmister. *Int. Petr. Techn.*, October, 1932, **9** (2), 91.—In order to calculate the exact size of a flow string several assumptions must be made, since a number of the necessary factors are still in the approximation stage. The author presents a graphical method for determining tubing sizes without the usual complicated mathematical calculations. L. V. W. C.

30. Merits of Tapered Flow Columns. J. T. Hayward. *Oil Weekly*, 21.11.32, 67, 10, 30.—Tapered tubing cannot change the gas-oil ratio of a naturally flowing well, since this ratio will depend only upon the rate of production and will be independent of the method and of the design of the equipment above the level of the producing sands in the well. Similarly, no economy in the reservoir energy can be expected by the use of tapered tubing.

The shape of the column cannot control the type of expansion, since this is governed by the specific heat of the mixture, the latent heat of the vaporising

fractions and a number of other factors. The type of expansion will, therefore, depend upon the available heat and the work done in lifting the oil-gas mixture rather than upon the shape of the column.

An increase in the size of the column towards the surface will permit of only a small increase in the amount of heat absorbed, except in very small wells.

In a column of constant cross section the variation in speed is great, and this entails too low a speed with excessive slip at the high pressure end and/or too high a speed with excessive friction at the low pressure end. Both the density and the velocity of the gas vary with the pressure, and the rate at which a drop will fall through a gas depends upon the density and consequently upon the pressure. It is not necessary, therefore, to maintain a constant gas velocity in order to carry a drop of fluid at a constant speed from the bottom to the top of the flow column, but the gas velocity must actually increase as the pressure and density fall.

The claim that isothermal expansion represents efficient, and adiabatic expansion inefficient, operation is disputed on the grounds that the greater the temperature drop in the flow column the higher the efficiency of the column.

The conclusions drawn from this study appear to indicate that: (1) Part of the theory at least upon which the superiority of tapered tubing has been predicted is open to attack; (2) the variation in velocity present in columns of constant cross section does not necessarily lead to excessive slip and friction, but a considerable increase in velocity as expansion proceeds is desirable; (3) tests have failed to detect any superiority for the tapered columns. L. V. W. C.

31. Study of Impact Stresses in Pumping Wells through the Use of the Tachometer W. J. Crites and D. R. Knowlton. *Inst. Petr. Tech.*, Oct., 1932, **9** (2), 65–68.—In order to obtain more definite information with reference to load characteristics the dynamometer was developed. This instrument reflects the load with reference to stroke position throughout the cycle of operation not only as influenced by the weight of the load, but also by the power application and the condition of power transmission and load equipment. In addition to a determination of the stresses it is also important to know the variation of stress in detail and the time relation with reference to the cycle of operation.

Unless the variation of stress results in impact loads it is not highly destructive. Unfortunately the dynamometer does not reflect impact loads in detail, and in order to study motion or interruption of motion, which results in impact loads, a recording tachometer was used.

Destructive stresses in the pumping of oil wells have two origins, the load and the power unit. The dynamometer does not give a sufficiently close study of the factors influencing the destructive effect of applied power. By means of the tachometer the stresses are not measured, but the motion is and any variation of motion is an index to the variation of stresses.

A number of curves are given to illustrate the results obtained.

L. V. W. C.

32. Removal of Paraffin Deposits in Small Tubing. Anon. *Petr. Eng.*, Nov., 1932, **4** (2), 48.—Paraffin deposited in tubing strings can be removed by means of a device consisting of a rod to which is attached a number of cutting blades. These blades are usually $\frac{1}{8}$ in. smaller in diameter than the tubing and are brazed into slots cut in the rod so that they may be set at any desired angle.

A sinker bar to give sufficient weight to overcome the well pressure is placed immediately above the rod, and above the sinker is placed a socket.

The tool is given an up-and-down motion, and this vertical movement, together with the angles at which the blades are set, gives a circular motion, thus completely scraping the tubing face.

If the well is flowing naturally the paraffin removed is carried out of the hole by the flow. If the well is being pumped the paraffin is bailed out.

L. V. W. C.

33. Paraffin Trouble to Increase as East Texas Pressure Declines. J. M. MacQuarrie. *Oil Weekly*, 7.11.32, **67** (8), 14.—The crude oil produced in the East Texas field contains paraffin, which may be deposited on the sand-face, in tubing, etc., if conditions become favourable.

The accumulation of paraffin in conductors has not, as yet, become a serious problem in this field, but as pressures decline an increase of the trouble may be expected. The depth at which the paraffin is deposited usually ranges from 400 to 900 ft. from the surface, and it has a melting point of about 184° F.

With a decrease in temperature the ability to hold paraffin in solution decreases until the saturation point is reached where the paraffin begins to precipitate in small crystals. With agitation these small crystals unite and form larger grains, which readily adhere to a rough surface. The temperature may be reduced by cooling due to gas expansion and by radiation losses.

The presence of fine sand acts as a nucleus for the formation of large particles of paraffin, which can become readily attached to the surface of a conductor.

The accumulation of paraffin can be controlled either by preventing its separation or its deposition.

If deposition has taken place the paraffin may be removed by: (1) mechanical means; (2) chemical means; (3) operating practice.

The conclusions drawn by the author are:—(1) Maintain temperature sufficiently high to keep the paraffin in solution; (2) high velocity is necessary to keep the paraffin from depositing; (3) gas oil ratio should be kept as low as possible; (4) avoid loss of volatile constituents; (5) mechanical scrapers and chemicals can be successfully used; (6) conductors must be kept full at all times; (7) tubing in pumping wells should be so arranged that the sand cannot be uncovered.

L. V. W. C.

34. Free Gas and Gas Oil Ratio Important Factors in Regulation of Flow Rate and Recovery. J. R. McWilliams. *Oil and Gas J.*, 24.11.32, **31** (27), 12, 13.—The production of gas from any pool is assured regardless of the methods of production, but the percentage recovery of oil will be primarily dependent upon the methods. If the production of oil were given primary and the gas secondary consideration, there is little doubt but that higher oil recoveries could be obtained, but there is little incentive in most pools to control the gas production. On the other hand the major portion of the preventable waste occurring to-day is caused by an inadequate control over gas production. Residue gas is blown to the atmosphere and the waste includes not only the natural gas, but a large quantity of oil which is left underground by the removal of this energy.

Those oil wells which can produce the maximum oil recovery do not, as a whole, require the free gas to obtain such recovery, since it is believed that by far the larger portion of the recovered oil is moved to the wells by water drive and/or the compressed gas originally dissolved in the oil. The free gas, therefore, accounts directly for a very small percentage of the oil actually recovered. The effectiveness of water drive and gas energy will depend upon pressure maintenance, which is seriously affected by the withdrawal of large volumes of free gas from the pool. The proper time to recover free gas is, therefore, after the recoverable oil has been produced.

Water encroachment never fully compensates for oil and gas withdrawal and pressure maintenance in practice must mean a slow rate of pressure decline unless gas is injected. Thus, even if the free gas is maintained intact in the pool until the recoverable oil has been produced, there would still be some pressure decline which would result in a spread of the gas cap and cause less gas to occupy the porous space between each gas property, and a fringe of semi-oil area originally surrounding the gas cap would become a gas area. High gas oil ratio wells would result in this semi-gas area, and these should be delayed if the ultimate recovery from the pool is to be as large as possible.

The result would not be equitable, but the increased oil recovery to the remaining owners would justify ample compensation for those operators who have suffered. The legal complications are considerable, but not insurmountable.

Reinjection of the residue gas is one solution of the problem and gas and oil proration has been suggested as another possible solution. L. V. W. C.

35. U.S. Patents on Drilling Apparatus.—R. P. Simmons. U.S.P. 1,880,214, 4.10.32. Well drilling apparatus.

R. P. Simmons. U.S.P. 1,880,215, 4.10.32. Drillhead attachment for core barrel.

R. P. Simmons. U.S.P. 1,880,216, 4.10.32. Under-reamer.

R. P. Simmons. U.S.P. 1,880,217, 4.10.32. Motor driven well drilling apparatus, motor driven by compressed air delivered to the bottom of the string.

R. P. Simmons. U.S.P. 1,880,218, 4.10.32. Method for lining oil wells.

F. B. Jackson. U.S.P. 1,880,321, 4.10.32. Well pumping apparatus.

C. E. Lang. U.S.P. 1,881,024, 4.10.32. Drill bit.

J. B. Triplett. U.S.P. 1,881,035, 4.10.32. Well reamer.

F. I. Epley. U.S.P. 1,881,176, 4.10.32. Combination of a rotary drill shaft and a steam pump. The mud fluid fed into the drill pipe is passed through a condenser and is used as a cooling medium.

A. Brynton. U.S.P. 1,882,060, 11.10.32. Automatic device for flowing wells.

E. C. Ekstromer. U.S.P. 1,882,069, 11.10.32. Electro-mechanically operated pumping system.

J. E. Trouth. U.S.P. 1,882,099, 11.10.32. Cementing head.

J. H. Kaumans and E. Bridges. U.S.P. 1,882,149, 11.10.32. Drilling jar.

J. D. Nixon. U.S.P. 1,882,230, 11.10.32. Packing anchor.

C. E. Burt. U.S.P. 1,882,314, 11.10.32. Floating and cement shoe.

L. M. Brigham. U.S.P. 1,882,545, 11.10.32. Drilling bit.

H. J. Hammer. U.S.P. 1,882,572, 11.10.32. Well testing apparatus.

W. L. Church. U.S.P. 1,882,650, 11.10.32. Well spear.

G. V. Powers. U.S.P. 1,882,894, 18.10.32. Collapsible joint for drill stems.

H. R. Standlee. U.S.P. 1,883,053, 18.10.32. Well swab.

F. Stone. U.S.P. 1,883,071, 18.10.32. Lockable safety joint for drill stems.

M. C. Allen. U.S.P. 1,883,321, 18.10.32. Core drill. L. V. W. C.

Class 400. Transportation, Storage and Distribution.

36. Gum Deposits in Gas Distribution Systems: I. Liquid-Phase Gums *(continued)*. A. L. Ward, C. W. Jordan and W. H. Fulweiler. *Ind. Eng. Chem.*, 1932, **24**, 1238.—Various types of manufactured gas contain relatively large quantities of butadiene, cyclopentadiene, styrene and indene, all of which

are capable of forming gums. Attempts to isolate and identify pure compounds from natural gums in an effort to establish which of the above hydrocarbons were responsible for their formation were unsuccessful. The synthesis of gums from the hydrocarbons in gas condensate led to the discovery that a quantitative relationship could be established between the styrene and indene formed by the pyrogenetic decomposition of gums and the styrene and indene polymerised and oxidised to form them. It was demonstrated that styrene and indene together are certainly responsible for at least 70–80% of liquid-phase gum as formed in gas distribution systems. Although styrene is present in about twice the quantity that indene is, and although styrene is polymerised and oxidised with greater rapidity than is indene, the latter accounts for 1·8 to 4 times as much gum as does the former. Natural gums are contaminated with leather (from meters) and iron oxide. The nitrogen and ash contents have led to the assumptions that the gums are products of oxides of nitrogen and also that they are salts of organic acids. Neither type of compound is an essential constituent of liquid-phase gum. Mercaptans and phenols are strong positive and negative catalysts, respectively, for the polymerisation and oxidation of styrene and indene, and hence for the formation of liquid-phase gum. Both classes of compounds are naturally present in certain types of manufactured gas; their relative quantities affect the quantity of gum formed, particularly in mixed gas. The absence of liquid-phase gum in systems distributing coal gas and coke-oven gas under a thermal standard is due to the fact that such gas does not contain a sufficient quantity of styrene and indene to form the oily condensate which is the first step in the formation of this type of gum. W. H. T.

37. Metallurgical Aspects of a New Oxyacetylene Method of Welding in the Oil Industry. F. C. Hutchinson. *Oil and Gas J.*, 20.10.32, **31** (22), 74.—The chief features of a new oxyacetylene welding method are the uses of: (1) A carbonising flame instead of a neutral flame; (2) special welding rod; (3) a special but simplified welding technique. The process is based on the utilisation of the deoxidising power of carbon present in the oxyacetylene flame—to prevent oxidation and to reduce any oxides present. When an excess acetylene flame was used, it was found not necessary to puddle the base metal in order to obtain a perfect weld, while the molten weld metal tended to flow readily over the molten carburised surface just ahead of the advancing puddle. The excess acetylene takes advantage of the functions of carbon in: (1) reducing iron oxide; (2) diffusing readily into iron; (3) formation with iron of an alloy having a melting point several hundred degrees below that of steel.

The use of a special welding rod prevented the usual tendency for blow-hole formation when excess acetylene is used. The ability to produce a weld without melting the base metal prevents dilution of the rod metal with base metal, so that with the special welding rod used the quality of the weld is superior to that of the base metal. Ductility is high owing to the soundness and oxide-free character of the weld metal.

The technique of the welding operations is discussed, attention being drawn to the use of a special blowpipe which increases welding speed by 30%/50% and renders operations almost automatic. C. L. G.

38. Fluid Cooled Pipeline Pump. Anon. *Int. Petr. Tech.*, Oct., 1932, **9** (2), 98.—This booster pump is a self-contained type, electrically driven with the motor cooled by the gasoline which is being pumped through the line. It

consists of three sections, a motor section, a spacer section and the pump section. The fluid enters at the outboard end of the motor section and passes through a double wall jacket the length of the motor and then across the spacer section to the pump. The pump is an eight stage unit with two sets of impellers, giving four stages each in opposed arrangements to minimise the thrust. After the fluid leaves the first four stages it goes out overhead to the outboard end of the pump, and then is driven through the second four stages toward the suction to the high pressure or discharge end of the pump, leaving at the middle of the housing.

In the spacer section are the inboard end of the pump and the motor bearings and a fast flexible coupling for connecting the two together. A sump for lubricating oil is provided from which a small gear pump takes its supply, passes it through the heat exchanger and thence to all the bearings.

The motor gives an efficiency of 96·5% at full load, owing to the design which requires no air circulation for cooling, thus reducing the windage friction to a minimum. With a pump efficiency at full load of 83·2% the overall efficiency of the unit is 80%.

No housing is required for this unit and its weight permits of the use of very light foundations. L. V. W. C.

39. Essentials of Fluid Volume Measurement. A. D. MacLean. *Int. Petr. Tech.*, Oct., 1932, **9** (2), 99.—In order to produce a measuring device suitable for the oil industry a number of facts must be considered. Accuracy is necessary if the standard limits are to be obtained. Where the rate of flow is constant, meters are available which will give a high degree of accuracy, but many types of meters become extremely inaccurate when operated at a widely varying rate of flow. The device must be capable of withstanding the maximum pressure encountered and the pressure absorbed by the metering device is one of importance. Ease of reading and of installation must, of course, be considered. Dirt must be excluded from the meter and inclusion of gas should be prevented in those devices adversely affected by gaslocks. The material from which the meter is constructed should be resistant to corrosion, and all devices should lend themselves to simple and ready replacement or repair. Complications arise in the design of meters for crude oil due to the physical characteristics of the oil, and some attempt should be made to define these characteristics to a degree complete enough to carry out accurate measurements.

The devices which have already been developed for some particular measuring problem and which might be adapted for the measurement of crude oil are : (1) Inferential types (venturi and orifice) ; (2) positive types (rotating disc and piston) ; (3) velocity operated type (straight impeller) ; (4) combined positive and velocity types (confined impeller) ; (5) weight types.

Generally for crude oil measurement when the liquid is dirty the confined impeller type appears to be most satisfactory. For large pipeline work under good conditions the inferential type with integrating and recording attachments is satisfactory, but expert care and use is presupposed. The piston type meter has been applied satisfactorily to the measurement of gasoline, lubricating oil and grease, whilst for refined oils the direct piston and cylinder type offers a very good solution.

It is important that in all measurements the standard must be observed, and this may mean that gallons and barrels require a further definition.
L. V. W. C.

Class 500. Properties and Their Determination.

40. Analyses of Petroleum Products. A. F. Dobriansky. 2nd Edition, 1932, Pp. 372.—The work is an outline of various methods for the examination of petroleum products, ozokerite, native asphalt, etc., as well as a general reference book providing as it does a fairly complete criticism of each method, stressing its merits and defects. Most of the methods are those universally used; some were developed to meet the local conditions. The author has collected a lot of information scattered among the technical journals and gives in each chapter a good theoretical interpretation of the subjects, enabling a better selection of methods and making even the simplest operation full of significance. In his book the author has paid especial attention to the problems connected with aromatic hydrocarbons in view of the importance of such admixtures in motor spirits. The present edition has been generally brought up to date by inclusion of new chapters on cracked petrols and anti-knock dopes and by enlarging the chapter on gas analyses. The appendix to the book contains tables of physical data, bibliography and a comprehensive index. On the whole, the author treated his subject with a commendable enthusiasm and, in the absence of suitable text books, the present edition fills an important gap in the technical literature of the U.S.S.R. P. A.

41. Densities of Saturated Vapours. R. Wright. *J. Phys. Chem.*, 1932, **36**, 2793.—A method is described for the determination of the density of a saturated vapour at the boiling point of the liquid yielding the vapour.

A small quantity of the liquid is placed in a previously weighed, stoppered bulb of 100 ml. capacity, and this bottle is supported by brass or silver wires above 50–100 ml. of the same liquid in the outer jacket of a V. Meyer apparatus. The wiring is arranged so that a spiral of platinum wire touches the bottom of the bottle and the application of a suitable current causes evaporation of the liquid in 15 minutes. The procedure is to boil the liquid in the outer jacket until the vapour rises well above the top of the bottle, which is unstoppered during the heating. The liquid in the bottle is then heated by the spiral, and after evaporation the current is stopped and the apparatus left for 10 mins. till the temperature of the bottle falls to that of the surrounding boiling vapour. The bulb is removed and immediately stoppered. After cooling to room temperature the stopper is loosened to admit air and the bottle weighed. A correction is made for the air excluded from the bottle by the vapour, this volume $= \frac{P}{B} V$ where B = barometric pressure, P = pressure due to vapour, V = volume of bulb and if multiplied by the weight of 1 ml. of air gives the required correction. The difference in the two weighings now gives the weight of vapour in the bottle, and together with the volume of the bottle sufficient data are available for the calculation of the density.

The vapour pressure of the liquid at the temperature of the weighing may be obtained from tables or determined directly by a simple method described by the author.

The system chloroform-acetone was investigated (using the constant boiling mixture) for the formation of complex molecules, but the results indicated that in the vapour state there is no union. E. N. H.

42. Partial Vapour Pressures and Refractivities of Binary Mixtures of Benzene and some of its Polar Derivatives. A. R. Martin and B. Collie. *J.C.S.*, 1932, 135, 2658.—In order to obtain some data preparatory to an investigation on

the part which dipole moment and dielectric constant play in determining the properties of polar liquids, the authors have measured the partial vapour pressures and refractivities of mixtures of polar with non-polar liquids in known molecular concentration. It was expected that interaction between the polar molecules would be detectable by changes in refractivity.

For the purpose of simplicity, compounds were chosen with one symmetrical dipole per molecule such as chloro and bromo benzene, anisole, aniline, dimethylaniline, benzonitrile, and phenol (refractivities only were taken for the last).

Benzene made a convenient non-polar solvent having similar chemical structure and molecular size to the polar compounds.

These were each suitably purified before use. Vapour pressures were measured at 70° to obtain values of convenient magnitude.

Refractivities and densities were measured at 25° C. to avoid evaporation losses.

The method and apparatus for determining vapour pressures received careful consideration, in view of the wide difference in volatility of some of the components of the binary mixtures.

Eventually, the method of Sameshima (*J. A.C.S.*, 1918, **40**, 1482) was adopted with a modification which ensured that the returning distillate was thoroughly mixed with the contents of the still.

A full description and diagram of the apparatus so modified is given.

Refractive indices were measured for the Hα line at 25° C. with a Pulfrich instrument. The results obtained are presented in tabular form, and the observed values compared with the calculated values for mol-refractivities. The close agreement between the observed and calculated values shows that the partial molal refractivities are constant over the whole concentration range.

The only approach to a systematic departure from constancy was in the case of benzonitrile, the most polar liquid examined. An interpretation of the results has been attempted in terms of the dipole moment and molecular radius of the polar molecules and the dielectric constant of the medium. Such interpretation must necessarily be incomplete until all the dielectric constant data is available. S. B.

43. Solubilities of Oil and Waxes in Organic Solvents, III. J. W. Poole and T. A. Mangelsdorf. *Ind. Eng. Chem.*, 1932, **24**, 1215.—The effects of temperature and oil-solvent ratio on the solubility of paraffin wax have been studied for solvents found by previous work to show a definite promise. A consideration of all the data secured up to the present has enabled general equations to be developed for wax solubility, applicable to all conditions of temperature or oil-solvent ratio, provided that only one phase—solvent-in-oil—exists. The general expression for wax solubility is given as :—

$$\log Ws = A(\log T - Ks) \qquad \text{where } T = \text{absolute temp. (° C.)},$$

A = a constant dependent on wax (for this investigation 38·5), Ws = gms. of wax per 100 gms. of solvent and Ks = a function of the solvent. As this expression does not give even approximate results for solutions containing oil, it has been modified to provide for three component mixtures, as follows :—

$$W = aT^A + L.bT^B, \qquad \text{where } A = 38{\cdot}5, \quad B = 29{\cdot}4, \quad \log_{10} a = -AKs,$$

$\log_{10} b = B\,Ke$, L = solvent ratio, Ke and Ks being solvent constants in which $Ke = Ks - 0{\cdot}0268$. W, the total wax dissolved in 100 gms. of solvent and 100 L gms. of oil at any desired temperature, may thus be determined, provided that the constant Ks (a characteristic of the solvent) has been determined from a single solubility determination of wax in pure solvent. A table is given of values of Ks for 40 solvents. W. H. T.

44. Measurement of the Viscosity of Tar. G. Barr and A. L. Thorogood. *J.S.C.I.*, 1932, **51**, 381–392T.—The original Hutchinson tar tester (similar in design to a metallic hydrometer, and to the "Consistometre E.P.C." used in France) involved the use of ½-gallon of tar for each test at 25°. Later a Hutchinson Junior tar tester was developed for testing much smaller samples. The numerical values denoting viscosity by both Hutchinson testers on the same tar at the same temperature are stated by the designers to be identical. In 1929, the British Road Tar Association introduced a new viscometer for the examination of tars. It is similar in general outlines and method of manipulation to the Redwood viscometers, and it is employed at a standard temperature of 30° (Specifications of the B.R.T.A. Viscometer and the Hutchinson Tar Tester are included in the "B.E.S.A. Specification for Road Tars (Nos. 1 and 2) for Road Purposes No. 76, 1930").

The paper deals comprehensively with the characteristics of the last two instruments, the object being to test the rigidity of the dimensional specification laid down for the "tester" (dealt with in Part I. of the paper), and to obtain calibration constants for the two instruments (Part II.).

Part I. The Hutchinson Junior Tar Tester.—Several solid models which were made, varied in some of the dimensions, and were counterpoised so that the "net apparent weight" of each was equal to that specified for the tester. The tar container (normal dimensions) was maintained at a uniform bath temperature of 25°±0·05° by thermostatic controls. These counterpoised solid models, and a standard Junior tester, were then used for two coke-oven, two vertical-retort, and two horizontal retort tars ($d^{25°C}$, free carbon and ash contents are quoted). From the experimental results obtained the following conclusions were derived:—

(1) Duplicate tests with the Junior tester are liable to diverge by ±5%. (2) *The maximum diameter* is the most important dimension and should be specified to ±0·2 mm. (3) *Diameter of spindle and of ball.* Errors of even ±0·2 mm. should not produce appreciable differences in time of fall. (4) *Distance between timing marks.* An error of 0·5 mm. will produce an error of 1% in time of fall. The marks should preferably be cut on the stem. (5) *Biconical bulb.* The angles are not critical, but should be fixed to not more than ±1°. (6) *Position of bulb and timing marks.* The different heights would be measured easier from the bottom of the ball. (7) *Straightness and balance.* Noticeable errors of time occur when the tester does not fall vertically. Verticality should be checked with the tester resting on the bottom of a vessel containing a liquid of $d^{15·5}$ 1·2 (sucrose solution) and checking should be repeated when damage is suspected. (8) *Mass and volume.* Since the time of fall is directly proportional to the apparent weight when immersed in tar, the present tolerance of ±1·5% might well be reduced to 1% or less. (9) *Theory.* The investigation has shown that under the conditions of test there are no considerable deviations from viscous flow in the tars examined.

Part II. Measurement of the Absolute Viscosity of Tar and Determination of Calibration Constants for Two Types of Tar Viscometer.—The absolute viscosity determinations were obtained by the falling sphere method. The spheres used were steel ball bearings, 1/32, 5/64 and 5/32 in. diameters. The tars were contained in thin-walled glass tubes 15 cms. long, 2·5 cms. diameter which were filled to a height of 14 cms. These were immersed in a water thermostat, and the motion of the spheres was observed by a system of X-ray photography.

Variation of Viscosity with Time and Temperature.—One or two of the tars showed very striking discrepancies between viscosities deduced in experiments made on different days, and this was found to be due most

probably to thermal hysteresis. Storage at air temperature (around and below 18° C.) for a few days produced an increase in the apparent viscosity at 25° C. Warming to 30° C. or higher caused a reduction, and the effects of different thermal treatments were only very slowly reversed when the temperature was maintained at 25° C.

Before carrying out the absolute viscosity determinations, therefore, the tars were heated to 45° C. and then shaken.

The times of efflux of 50 mls. from the B.R.T.A. Viscometer were made on these six tars at the normal temperature of 30° C. and also at 25° C. The tests were easily manipulated and concordance between duplicates was good, if care was taken with the stirring and temperature regulation. At 30° C. duplicates usually agreed within 1%, and at 25° C. the differences reached 7% with one of the more viscous tars.

The Hutchinson times of the tars were determined with a Junior tester at 25° C., stirring of the tar and observation of the time of fall being repeated until a mean figure having a probable error within ±5% was obtained.

From these results the following equations were derived, whereby the absolute viscosities corresponding with various Hutchinson or B.R.T.A. times for tars which are employed under such conditions that the building-up of a structure in the liquid is rendered unlikely.

The Hutchinson tester :—

$$\eta = 1{\cdot}67\ (M - V\rho)\ T_H,$$

where M = weight of tester in air, grams, V = volume of tester in mls. ρ = density of tar, grams per ml. at t° C, T_H = Hutchinson time in seconds at t° C., *i.e.* $(M - V\rho)$ = apparent weight of tester in the tar.

The B.R.T.A. Viscometer :—

$$\eta = 4{\cdot}44\rho T_B,$$

where ρ = density of tar per ml. at t° C., T_B = B.R.T.A. seconds for 50 mls. efflux at t° C.

The validity of the B.R.T.A. constant (4·44) was checked by deductions based on Bond's experiments (*Proc. Roy. Soc.*, 1922, **34**, 139) on flow through orifices and short tubes. The value obtained by these theoretical calculations amounted to 4·2, which should presumably be reduced by about 5% for reasons given. But in any case, the value agrees with the mean value of 4·44 deduced from the experiments, as well as can be expected in view of the inaccuracies attached to both methods.

The mean values of the constants for these instruments were derived from results obtained on only three of the tars, so that any conversion factors must be regarded with some suspicion unless some carefully specified procedure is adopted for defining the extent of development of structure.

Also, in view of the large differences between the viscosity-temperature coefficients of tars (the viscosities at 25° C. may be from 1·9 to 3·0 times that at 30° C.), it is impossible to expect any conversion factors for comparing Hutchinson times at 25° C. with B.R.T.A. times at 30° C. to have an accuracy better than ±20%. C. I. K.

45. Viscosities of Diluted and Undiluted Oils in a Temperature Range of 30° to +50° C. J. Tausz and H. Mellner. *Petr. Zeit.*, 9.11.32, **28** (45) 1–10. —These were determined for various fatty and mineral oils with and without toluol as a diluent in a special viscometer—modified Dallwitz-Wegener Viscometer. The following oils were used : castor oil, linseed oil, peanut oil, oleic acid, Shell Voltol, Mobiloil A, Edeleanu extract, refined Russian machine oil and refined asphalt-base motor oil and temperature-viscosity curves drawn.

The viscometer consists of an endless screw rotating in a casing which is provided with a graduated tube through which the oil is forced. The tube

readings give direct kinematic viscosity and screw revolutions of 0·5—100/minute can be recorded. The apparatus was modified for low temperatures by using a toluol manometer consisting of a capillary tube fitted with a membrane composed of acetylcellulose. For very low temperatures solid carbon dioxide or liquid air was placed in the screw housing.

The per cent. of diluent was represented on the axis of x and the negative value of log. x on the y axis when straight lines were obtained for any oil where $x^n = x^{\frac{1}{2}n}_{2n} = x^{\frac{1}{4}n}_{4n} \ldots$ or $\eta^{xn}_n = \eta_{2n}$. The following symbols n, x_n, η represent wt. % of diluent, value of x in a mixture containing n% by wt. of diluent and viscosity respectively.

The results show that fatty oils generally had a melting or solidification point—*i.e.*, the temperature/viscosity curves were flat and steep. Castor oil was an exception. It was further observed that the value of x for most oils was independent of temperature and this fact was confirmed by experiment. The relation between the values of x could be calculated with the help of the viscosity of a viscous oil from two viscosity dilution determinations. The value of x was also a practical measure for oil dilution in the engine.

W. S. E. C.

46. Reactions of Unsaturated Compounds. I. Addition of Arylamines to Cyclohexene and 1 : 4 Dihydronaphthalene. W. J. Hickinbottom. *J.C.S.*, 1932, **135**, 2646.—The reaction of an olefine (trimethylethylene) combining additively with the nucleus of an aromatic amine having been observed (*J.C.S.*, 1932, **135**, 2396), the reaction has been studied further with reference to the behaviour of cyclohexene and of 1 : 4 dihydronaphthalene with aniline and p-toluidine.

1 : 4 dihydronaphthalene heated in sealed tubes at 200°–300° C. with a mixture of aniline and its hydrochloride or cobaltobromide was found to give mainly 2 p-amino phenyl 1 : 2 : 3 : 4 tetrahydronaphthalene together with a primary and secondary amine which were not identified. The orientation of the amino group was determined by conversion of the amine into the corresponding bromo compound and subsequent oxidation with chromic acid to p-bromobenzoic acid, thus establishing the formula for 2 p-amino phenyl 1 : 2 : 3 : 4 tetrahydronaphthalene.

Cyclohexene, when heated at 200–270° C. in sealed tubes with aniline and its hydrochloride, formed considerable amounts of cyclohexyl aniline, which was identified by the definite crystal characteristics of its p-toluene sulphonyl derivative. This reaction also gave two isomeric primary amines—one identified as 4-aminophenyl cyclohexane by comparison with a specimen prepared from cyclohexyl benzene—the other being presumed to be the corresponding ortho compound.

Although it was expected that the product resulting from the reaction between p-toluidine and cyclohexene would be less complex than that from aniline, and that the secondary amine would be present in greater amount and more easily isolated, actually the product consisted of a mixture from which 4 amino-3-cyclohexyl toluene and cyclohexyl p-toluidine were isolated in a pure state, the latter being identified by crystal characteristics and comparison of the free amine, its nitrosoamine and its toluenesulphonyl and other derivatives with specimens from another source.

The formation of secondary amines by this reaction can be considered in effect to result from the addition of $K.NH_2$ to the double bond, and is the first instance recorded of such an addition to an unsaturated hydrocarbon, this combination with the double bond being hitherto confined to the $\alpha\beta$ unsaturated acids and ketones.

As compounds containing the $-c=c-co$ group have, however, an unusual

facility for additive reactions with many classes of substance which are indifferent to unsaturated hydrocarbons, the addition of $K.NH_2$ to cyclohexene is unexpected.

Discussion on the nature of this reaction is therefore deferred until some possible hypotheses have been experimentally examined. S. B.

47. Higher Fatty Acids. W. Thévenaz. *Chem. Trade J.*, 1932, **91**, 395.—A résumé is given of the work of Raymond Vidal on the probable structure of the higher fatty acids and the preparation of detergent substances which possess all the qualities and avoid the defects of ordinary soap.

From an examination of the two products formed from the treatment of fatty acids with sodium hypochlorite Vidal considers that fatty acids cannot always be considered as having the generally accepted formula R.COOH, but exist in two forms: (1) the normal acid, with an aldehydo-alcoholic function or carboxyl group at the end of the chain, and (2) the hydrolysed trihydroxy form generally known as the ortho acid form. As the latter product cannot exist in the free state Vidal has assumed that the two forms react to form condensation products, *i.e.*, in the case of oleic acid, the oleic ester of the hydrolysed oleic acid is formed. This condensation would explain the so-called acid-acetate-palmitate-stearate, which may be regarded as acid salts of homologous esters, rather than mixtures of acids and salts.

The existence of the hydrolysed fatty acids is shown by the fact that they have quite distinct properties from the normal aldehydo-alcoholic form. (Details are given of these differences and of the possible compounds formed from the gradual removal of water from the hydrolysed acids.) The two compounds formed by the action of sodium hypochlorite or oleic acid are concluded to be: (1) The thick and nearly solid product is the oleic ester of the sodium derivative of the chlorolactone of the ortho oleic acid; (2) the liquid, water-soluble product is the monosodium derivative of the chlorolactone of the hydrolysed oleic acid.

The existence of oleic acid in a number of forms is well known, and Vidal's conception of the various esters offers a plausible explanation.

Commercial production of soap based on the second reaction has been successfully attained. "Crystal Soap" is a neutral water-soluble powder with detergent properties, even in cold solution, and is harmless to animal fibres, wool and silk. The soap can be blended with mineral oils, etc., for lubricating, cutting or wool oils. C. L. G.

48. Thermal Decomposition of Methane by a Carbon Filament. H. H. Storch. *J.A.C.S.*, 1932, **54**, 4188.—In using carbon filament lamps the author's objectives were: (1) to isolate the early products of pyrolysis by immersing the walls of the bulb in liquid nitrogen or oxygen; (2) to avoid loss of hydrogen, such as occurs with silica; (3) to study the reaction on a carbon surface.

Using liquid nitrogen and with the carbon filament at 1700° C. only very small pressure changes were observed despite the production of considerable quantities of hydrogen. The conclusion was drawn that in the absence of carbon or tarry matter, ethane must have been produced. In one experiment as much as 95% of the theoretical yield of ethane was obtained. Ethylene formed a large part of the unsaturated hydrocarbons produced.

To determine the effects of the presence of methane and the filament temperature on the rate of the pyrolysis three series of experiments were made: (1) Using the lamp immersed in liquid oxygen (at −183°); (2) with the lamp in alcohol and solid carbon dioxide at −78° C.; (3) in ice water at 0°C. At −183° C. with pressures from 1–9 cm. a first order reaction was indicated, while in the range of pressure from 11–23 cm. almost twice as

much acetylene was formed as at the lower pressures and the order of the reaction increased to almost second order. Both at —78° C. and 0° C. the products of pyrolysis were mainly carbon and hydrogen and pressure measurements were an indication of rate. At low pressures the reaction was first order, but increased toward second order with increase in pressure.

The author averaged heats of activation from the three series of experiments and produced a figure of 77,170 ± 10,000 cal./mol. of methane. The influence of hydrogen on the rate of the decomposition was studied, and the data obtained can be satisfactorily explained by a rate equation based on a number of successive dehydrogenation steps following the initial synthesis of ethane.

E. N. H.

49. Automotive Engine and its Fuel. G. Edgar. *J.S.A.E.*, 1932, **31**, 461–464.—A discussion of the properties of gasoline, especially detonation qualities, in relation to engine performance. It is suggested that anti-knock gasolines are economical even for use in commercial vehicles. The author believes that the limit of engine performance with a given fuel has not yet been reached by the designer. E. B. E.

50. Work of the Cracked Fuels Committee. F. H. Garner. *J.I.A.E.*, Dec., 1932, 40-46.—This article is an appendix to the Report of the Empire Motor Fuels Committee and is concerned with the knock-ratings of typical olefine hydrocarbons likely to be present in cracked motor fuels.

Tests on the E.35 engine indicated that ethylene preignited at high compression ratios, and even at low compression ratios as soon as the mixture was enriched to approach maximum power conditions. Subsequent experiments on the E.5 sleeve valve unit indicated that the hot exhaust valve heads of the E.35 were probably causing this preignition. The experiments showed that the anti-knock value of ethylene in terms of pure benzene was greater in the E.5 than in the E.35: *e.g.*, 50% by weight ethylene in a straight run gasoline showed an increase in H.U.C.R. of 1·9 in the E.5 and 1·3 in the E.35, the corresponding benzene-straight run gasoline blend giving H.U.C.R. increases of 1·15 and 1·1 in the respective engines. In addition, ethylene could be used alone at maximum power mixture strength at C.R.'s up to 8·25/1 in the E.5 before preignition occurred, whereas in the E.35 preignition occurred at 3·8/1 C.R. The ignition advance for maximum power with ethylene in the E.5 was less than that required for a straight run gasoline, *viz.*, 20° and 28° respectively at 6·0/1 C.R. Ethylene would appear also to have a greater available range in mixture strength than a straight run gasoline.

Experiments with amylene in the E.35 indicated that up to about 60% concentration in a straight run gasoline, amylene and benzene are approximately of equal influence in suppressing detonation. The report then describes the work of Garner, Wilkinson and Nash (cf. Abstr. 971/1932) on the α olefines, and gives additional information on the blending octane numbers of several isomeric olefines, determined on the S.30 engine at 212° F. and 300° F. These hydrocarbons are 2 – methyl hexene – 5, di-allyl, heptene – 3, trimethylethylene, pentene – 2, and 3 – ethyl pentene – 2. The lead susceptibility at 212° F. and 300° F. jacket temperature has been determined in most instances. W. E. J. B.

51. Propagation of Flame in Electric Fields. II. Effect of Transverse Fields. E. M. Guenault and R. V. Wheeler. *J.C.S.*, 1932, **135**, 2788. It is shown that the changes produced by a transverse electric field on the speed of propagation of flame are due to changes in the shape and area of the flame surface. It is concluded from the nearly constant relationship between the speed of flame under the influence of an electric field and the area of

its surface with or without the field, that the field had no effect on either the character or the speed of the chemical reactions. The changes that occurred in the shapes and areas of the flames can be explained as being due to a mechanical drag exerted by the field on the flame, which behaves as a positively charged mass of gas. The nature of the ions present in the flames and the mechanism of their production have not yet been fully elucidated. W. H. T.

52. Mechanism of Flame Movement: II., The Fundamental Speed of Flame in Mixtures of Methane and Air. H. F. Coward and F. J. Hartwell. *J.C.S.*, 1932, **135**, 2676.—The uniform movement of flame in mixtures of methane and air has been examined photographically, and from the measurements obtained it has been deduced that the volume of gas burnt in unit time is proportional to the area of the flame front. The latter is determined by the diameter of the tube and by convection currents set up by the difference in density between the burnt and unburnt gases. The flame is rarely a flat disc at right angles to the axis of the tube, and hence its axial speed is greater than that in a stationary mixture. Uniform flame movement established soon after ignition at the open end of a tube closed at the other end, is characterised by constant dimensions of the flame front. These are maintained so by a balance between the effects of a constant speed of propagation of flame normal to the flame front and a steady operation of the convection effect. Uniform movement develops into a vibratory movement, but in either case it is probable that the volumes of gas burnt by unit flame area in unit time are the same. As the effect of gentle turbulence due to convection is to increase the rate of consumption by increasing the area of flame front, the effect of violent turbulence is probably due to the same cause. W. H. T.

53. Oxidation Test for Stability of Benzoles on Storage. W. H. Hoffert and G. Claxton. *Gas World*, 1932, **97**, 560–565.—A discussion of the significance of preformed and potential gum in motor benzoles is given, and followed by a description of the oxidation test recently standardised by the National Benzole Association as an alternative to the acid washing test.

One hundred ml. of the filtered sample is heated in a 250 ml. round-bottom flask for 3 hours on the boiling water bath. The flask is fitted with a water condenser to minimise losses of material, and a current of oxygen at the rate of 35 ml. per minute is bubbled through the liquid during the heating. Full details and dimensions of the apparatus are given.

The condenser is then replaced by a distillation head and 75 ml. of the benzole distilled off over a free flame. The residue is transferred to a weighed 75 ml. pyrex dish, and evaporated on the water-bath for 1½ hours. After drying for 1 hour in the steam oven, the residue is weighed and represents the sum of the potential and the preformed gum. Preformed gum may be determined separately by distilling off 75 ml. of 100 ml. of sample and evaporating the residue as after the oxidation test.

For benzoles giving up to 15 mg. per 100 ml. of potential gum, the results obtained in different laboratories should not differ by more than 2 mg. Direct sunlight should be avoided during the test, and precautions taken to ensure absence of impurities. The size of orifice and depth of liquid through which the oxygen bubbles are shown not to be critical factors. Benzoles stable to this test are stable under ordinary storage conditions.

An appendix discusses the calibration of the flowmeters employed.
E. B. E.

54. Properties of Liquefied Petroleum Gases as Affecting Specifications. T. W. Legatski. *Proc. Nat. Gas Assoc. of Amer.*, May, 1932, p. 49.—

Basis of specifications are considered having regard to user's and also producer's requirements.

In the case of commercial propane the following factors are considered and suggested for tentative specifications :—

(1) Definition : to mean a hydrocarbon product composed predominantly of propane and/or propylene ; (2) composition : to be at least 95% propane and/or propylene as determined by the combined results of vapour pressure and mercury freezing tests ; (3) mercury freezing test : the residue as determined by this test shall not exceed 2% by volume ; (4) vapour pressure : as determined by the N. G. A. A. method—shall not exceed 235 lb. per sq. in. at 105° F. ; (5) sulphur content : corrosive forms of sulphur are prohibited, total not to exceed 15 grm. per 100 cu. ft. of vapour ; (6) water content : entrained water to be absent.

In the case of commercial butanes, a similar but less drastic specification is proposed.

Details of N. G. A. A. tentative methods are given for mercury freezing point. Test determination of composition, vapour pressure and specific gravity.

In order that these materials have a characteristic odour so that they may give warning of their presence, it has in some cases been found necessary to add odorants. The compounds used for this purpose have to meet certain requirements such as cheapness, stability, inertness to metals, and be comparatively non-toxic. The compounds generally employed for this purpose are ethyl sulphide or mercaptan, pyridine and calodorant. S. B.

55. Inhibitors in Cracked Gasoline : I., Relation of Structure to Inhibiting Effectiveness. G. Egloff, J. C. Morrell, C. D. Lowry and C. G. Dryer. *Ind. Eng. Chem.*, 1932, **24**, 1375.—The existing published methods of gum determination are commented upon and a description is given of a bomb method of estimating the relative gum stabilities of cracked spirits and of evaluating the action of inhibitors. It is shown that many substances which increase the induction period in the bomb also prevent gum formation in cracked gasolines in storage and reduce the amount of gum deposited in the copper dish test. The most active substances are those with phenolic or aromatic amine groupings, but the action of a single grouping is relatively slight. Most of the effective compounds contained more than one hydroxyl or amine group, or a single aromatic hydroxyl or amine group with one or more alkyl or other modifying group, or an aromatic hydroxyl and amine group, or an aromatic secondary amine grouping. Modifying groups in amines and phenols were found to be most effective in the ortho or para position, but showed some influence when placed meta to the inhibiting group. Some nitro or halogen compounds, ethers, etc., were effective when containing an aromatic amine or hydroxyl group. W. H. T.

56. Analysis of Mineral Lubricating Oils by Fractionation with Acetone. M. Nottage. *J. Inst. Petr. Techn.*, 1932, **18**, 943–952.—A study of the extraction with acetone of two widely different lubricating oils. The course of the extraction was followed by a friction-temperature method. G. R. N.

57. Gravity Index for Lubricating Oils. W. B. McCluer and M. R. Fenske. *Ind. Eng. Chem.*, 1932, **24**, 1371.—A gravity index has been developed for the classification of oils as regards their base or type, by reference to data on a large number of lubricating oils or oil fractions. The basis for the gravity was so selected that index numbers similar to the viscosity index were obtained.

The viscosity-gravity constant A was calculated by means of the formula :—

$$A = \frac{10\,G - 1{\cdot}0752\,\log_{10}(V-38)}{10 - \log_{10}(V-38)}$$

where G = S. G. at 60° F. and V = viscosity at 100° F. (Say). The values of A when plotted against the viscosity index showed a definite relationship, from which an accurate graphical method has been developed for obtaining the index number from viscosity and S. G. data. It has been found that the index numbers of light oil fractions could be determined more accurately for a given degree of experimental accuracy by means of the viscosity-gravity relation than through the viscosities at 100° and 210° F. Satisfactory correlation has been obtained in all cases between the viscosity and gravity indices determined on 58 lubricating oils. W. H. T.

58. Relationship between Mole Fraction and Absolute Viscosities of Blended Lubricating Oils. E. R. Epperson and H. L. Dunlap. *Ind. Eng. Chem.*, 1932, **24**, 1369.—In the work described, a cryoscopic method of determination of molecular weight was adopted, using benzene, nitrobenzene and ethylene bromide. The Saybolt viscometer was used for the determination of viscosity, the values being converted to absolute values by means of the Herschel equation. The viscosities of a large number of binary mixtures of closely-cut fractions of Mid-Continent and Pennsylvania oils were determined, the results obtained being in good agreement with the values calculated by means of Kendall and Monroe's formula for ideal mixtures—$n^{\frac{1}{3}} = Xn^{\frac{1}{3}} + (1-X)n^{\frac{1}{3}}$ where n = abs. visc. of mixture and n_1 and n_2 = abs. visc. of components. The plotting of mole. per cent. against the cube root of absolute viscosity suggests a method for the prediction of the viscosity of blended oils from their mean molecular weights. W. H. T.

59. Roumanian Transformer Oils. N. Dănăilă and M. Boltus-Goruneanui *Petr. Z.*, 9.11.32, **28** (45). Motorenbetrieb, **5** (11), 4–7.—Paraffin-free Moreni crude oil was subjected, after the removal of benzine, to distillation under a high vacuum of 0·1—0·3 mms. of mercury. The apparatus consisted of a 5-litre copper retort fitted with a lid, together with a copper cooler and a Pfeiffer oil-pump capable of producing a vacuum of 0·02 mms. of mercury and having a suction power of 10 c. metres/hr.

It was found that a simple high vacuum distillation was insufficient to yield a good transformer oil. Those produced in this way without further refining had high tar values. Treatment of the transformer oil after distillation first with 15% of sulphuric acid of 80% concentration at ordinary temperature, and then with 5% of 80% acid at 60° yielded good transformer oils which were almost sulphur-free. W. S. E. C.

60. Stabilisation of Aqueous Dispersions of Asphalt. A. W. Hixson and J. M. Fain. *Ind. Eng. Chem.*, 1932, **24**, 1336.—For the examination of emulsions and the measurement of the size of dispersed particles, a microscopical projection method has been devised. The method used for the preparation of emulsions is given, together with details of a modification of Myer's demulsification test for bituminous emulsions. The addition of ferrous sulphate to a soap-emulsified asphalt containing potassium tannate alone or potassium caseinate alone, results in a deposit on screening. When these materials are both present, practically no deposit is obtained. In the former case, the deposit is due to precipitation of the soap by the heavy metal, insufficient time being allowed for stabilisation by means of the iron tannate. In the latter, the rates of reactions between caseinate and sulphate, and between tannate and sulphate, and the rate of subsequent concentrate of

iron tannate at the dineric interface are such that the iron tannate is formed and concentrated at the interface. This concentration is sufficient to stabilise the emulsion before the casein is precipitated where, in the absence of iron tannate, coalescence of the asphalt with a consequent formation of a deposit on screening would result. For the optimum dispersion of Mexican asphalt, in alkali tannate solutions, a fixed ratio exists, over a known concentration range, between the rates of change of tannin concentration and of alkali concentration. W. H. T.

61. Methods and Apparatus for Analysis and Measurement of Noise and Other Mechanical Vibrations Associated with Running Machinery. R. E. H. Carpenter and R. Stansfield. E.P. 382,292, 24.10.32. Appl. 22.6.31.—The invention relates to a method of and means for examining noises and mechanical vibrations produced by running machinery. It is particularly adapted for the estimation of knocking in petrol engines, and the various fuels being investigated can, by its means, be compared with blends of standard pure hydrocarbons. In a similar manner the combustion knock of fuels in compression ignition engines can be estimated.

A microphone serves to convert the sounds or vibrations into electrical variations and is connected to the input transformer of an amplifier. A potentiometer is provided to control the intensity of the electrical oscillations impressed on the transformer. A two-stage amplifier of known type is illustrated. To the secondary winding of the output transformer is coupled a rectifier which enables the oscillations from the amplifier to be measured by a direct current type meter. Across the output terminals of the amplifier is connected a selector or short-circuiting device which is coupled positively to the machine being investigated. By means of the selector, the noises affecting the microphone will influence the indicating device only during a succession of spaced time periods, each corresponding to the same portion of the cycle of operations. The length and position in the cycle of the time periods are adjustable at will. Not only does the selector mechanism reduce the effect of external noises, but it also makes it possible to isolate the noise due to any particular part of the machine.

The indicating device is usually arranged with adjustable damping, so that it can average the signal energy received.

In some cases it may be desirable to transmit vibrations to the microphone otherwise than through air. For this purpose a metal or other rod is fixed to the centre of the diaphragm and the free end of the rod is brought to bear on the vibrating member.

It is often desired to select certain frequencies out of those associated with a noise, and for this purpose frequency selective means may be associated with the apparatus. For this purpose a tuned or filter circuit may be provided between the microphone and the indicating device. Preferably the microphone itself is provided with a diaphragm so dimensioned that it exhibits a peak frequency response. The frequency at which the peak occurs is changed by changing to a diaphragm of different thickness.

The major claim made is the use of time selection in the examination of sounds and vibrations. J. G. W.

See also Abstract No. 103.

Class 600. Refining and Refineries.

62. Rotary Type Plate for Vacuum Fractionating Columns. D. B. Keyes. *Nat. Petr. News*, 9.11.32, **24**, 45, 22. The major principles of fractionation

and the application of these principles to general refining problems are outlined.

The thin film concept of contact between vapour and liquid is explained and the function of froth on the plate as an aid to fractionation is discussed. A brief description of a new type of plate for use in vacuum columns is given. A vertical shaft situated concentrically in the column shell carries a number of horizontal discs and is rotated at a fairly high speed. Liquid falling on to the top plate is thrown out in the form of a sheet of spray to the walls of the column from which it is returned to the next disc. The rising vapours pass successively through these areas of spray and excellent contact is claimed to have been obtained in the experimental units already tried. H. G.

63. Pressure Vessels for Oil Cracking. G. Egloff, J. C. Morrell and E. C. Leonhardy. *Ind. Eng. Chem.*, 1932, **24**, 1264. The methods of manufacturing riveted, seamless forged and electric welded pressure vessels are described together with the principles of electric fusion and automatic welding, and a typical specification (chemical and physical properties and tests) is given of a steel suitable for this type of vessel. Annealing of the steel and its effects are discussed and non-destructive tests of welds are detailed, photomicrographs of the structure of various types of welds being reproduced. The design of pressure vessels and the effect of shape on stress distribution are dealt with. The article is concluded with a short note on the strength of steel at elevated temperatures. W. H. T.

64. Formation of Coke in the Cracking Operation. A. W. Trusty. *Refiner*, 1932, **11**, 519–520. The formation of coke from various types of charging stocks is discussed, together with the influence of the method of operation of the cracking unit on the character of the products obtained. Three laboratory tests, carbon residue, tar number and aniline number are described which assist the refiner in controlling the cracking operation. B. C. A.

65. Winkler-Koch Cracking Unit. M. Kalita. *Refiner*, 1932, **11**, 585–588.—A description of the layout, operation and operating conditions of a Winkler-Koch Cracking Unit operating in Grozny. B. C. A.

66. Facilities for handling Petroleum Coke. Anon. *Refiner*, 1932, **11**, 531.—A description of a handling and conveyor system, operated by one man, for dealing with 65 tons of Dubbs Coke per day. B. C. A.

67. Hydrogenation of Petroleum Products. A. Sachanen and B. Tarasson. *Petr. Zeit.*, 16.11.32, **28** (46), 1–4.—Aromatic and olefinic hydrocarbons can only be hydrogenated under definite conditions of temperature and pressure when the corresponding methane and hydroaromatic hydrocarbons are produced. In the research described, hydrogenation was carried out in an Andreas-Hofer apparatus fitted with a stirrer and operated at 200–325° C. and 200 atm. for ½ – 3hrs.

In the first instance cracked kerosine of boiling range 195°–250° C. and containing 36% of aromatic and olefinic hydrocarbons was heated for 2 hrs. at 300° C. with 200 atm. of hydrogen, the latter increasing to 360–370 atm. during the experiment. The effect of hydrogenation with and without a catalyst was investigated together with the influence of pressure, temperature, catalysts, the condition of the catalysts. The same work was carried out using heavy distillates, the following being a résumé of the results obtained:

Hydrogenation of the kerosine without catalysts and at high pressures was very slow, 50% of the olefins undergoing hydrogenation in 3 hrs. whilst the aromatics remained unchanged.

When reduced nickel and cobalt were applied as catalysts in the form of a powder the velocity of the reaction was increased more than 10 times after a period of 3 hrs.; 80% of the olefins was hydrogenated and the aromatic hydrocarbons combined very slightly with the hydrogen.

The influence of pressure was shown by using the same catalyst at a temperature of 300° for 3 hrs. and 50 atm. of hydrogen increasing to 200 atm. Only 50% of the olefins was hydrogenated under the initial pressure of 50 atm. and 80% with an initial pressure of 200 atm.

The effect of temperature was investigated using the same catalyst with an initial pressure of 150 atm. of hydrogen with temperatures varying from 200–325° C. during 3 hrs. The temperature increased the velocity of the reaction, but not to the same degree as in cracking processes.

The condition of the catalyst had a marked influence on the reaction. The nickel catalyst when made into balls with kaolin was more effective than when applied in the form of a powder. The olefins were completely hydrogenated, also a slight quantity of aromatic hydrocarbons.

Various metals and oxides were utilised as catalysts (10% in the form of a powder) applying an initial pressure of 200 atm. of hydrogen and a temperature of 300° for a period of 3 hrs. A table is given showing the effect of CuO, Mn_3O_4, Bi_2O_3, Pbo, Zno, Fe_2O_3, Fe, Aq, etc. It was observed that many metals and oxides had no influence on the hydrogenation in the powdered form. Ferric oxide when prepared from the hydrate was more active than the commercial product, nickel and cobalt being the most effective.

Heavy distillates, *e.g.*, paraffin distillate and cylinder oil were found to unite with hydrogen at 300°, but not so easily as in the case of kerosine. Using initial temperature and pressure conditions of 300° and 200 atm. the reaction was slow for both distillates after a period of 10–15 hrs. and a periodic addition of catalyst was necessary. Hydrogenation with molybdenum compounds as catalysts had a greater effect with heavy distillates than nickel and cobalt or their oxides at 300° during 10–15 hrs. Increase of pressure hydrogenates 25–50% of the aromatic hydrocarbons. Increase of temperature increases the velocity of the reaction, but causes a cracking action to take place. W. S. E. C.

68. Action of Hydrogen on Steel. Anon. *Rev. Petr.*, 26.11.32, **503**, 1419.—A short review of experiments on the effect of hydrogen on steels of various compositions, *e.g.*, those used in petroleum hydrogenation plant, under conditions comparable with working conditions. Micrographical methods of examination were used. G. R. N.

69. Refining Process with Liquid Sulphur Dioxide. L. Edeleanu. *J. Inst. Petr. Techn.*, 1932, **18**, 900–920.—An address, by the recipient of this year's Redwood Medal, on the refining of petroleum oils with liquid sulphur dioxide. G. R. N.

70. Improvements in Refining of Lubricating Oils by the Edeleanu Process. W. Kain. *Refiner*, 1932, **11**, 553–557.—The refining effect of sulphur dioxide on lubricating oils is that of a selective solvent. Regardless of the type of origin of the petroleum stock and regardless of whether distillates or residual oils are treated, treatment with SO_2 results in a refined lubricating oil of lower specific gravity, lower Conradson test, and of a flatter viscosity curve. The degree of improvement and the yield of raffinate varies greatly and depends on the type of charging stock. Lubricating oil stocks containing large amounts of aromatics and unsaturates are more drastically refined than are those in which the paraffinic character predominates, and give the lower yield of refined oil.

Edeleanu treated transformer oils are more resistant to oxidation than oils given the usual sulphuric acid treatment, and refining losses are smaller. Similarly with any Edeleanu treated turbine oil tested under the same operating conditions over a period of two years compared with an acid refined oil from the same crude for a period of one year showed a much slower rise in sp. gr., viscosity, acid number, tar and tar-forming numbers.

As with light lubricating oils, the stability factor is the strongest argument in favour of the Edeleanu process with heavier stocks. In certain cases the action of SO_2 alone is not quite sufficient, but a subsequent acid treatment in these cases results in finished oils of higher quality than can be attained by the use of either reagent alone.

This double treatment is, however, not ideal by reason of the additional costs involved, and to meet these special cases a development of the process has been effected whereby a mixture of benzole and SO_2 is employed as the extraction medium instead of straight liquid SO_2. The addition of benzole in proportions ranging from 15–60% of the mixed solvent results in a considerable increase in solvent power and in better quality of the raffinate at the expense of yield. The type of oil under treatment, the desired quality and economic considerations determine the proportion of benzole to be used. The differences between the characteristics of the charging stock and the refined products is such as to render the origin of an SO_2 benzole treated oil untraceable. An after treatment of SO_2 benzole treated oils with sulphuric acid is not necessary, except in rare cases. The most suitable finishing treatment, if required, is clay treatment or rerunning in the presence of alkali. B. C. A.

71. Design of Gathering System in Natural Gasoline Plant Construction. Anon. *Refiner*, 1932, **11**, 532–533.—The importance of design in the elimination of losses due to friction in gasoline plant gathering lines is emphasised. The layout of a field gathering system, plant location and operation are described. B. C. A.

72. Water Injection into Gasoline Stream. Anon. *Refiner*, 1932, **11**, 584.—A gasoline stream from submerged condensers and after coolers attained a temperature of 104° F. By admitting water to the head of the after cooler sections, the temperature of the gasoline at the residuum tank was reduced on an average by 16° F. B. C. A.

73. Vacuum Stills in the Manufacture of Asphalt. J. C. Glenn. *Refiner*, 1932, **11**, 515–518.—A brief description of eight recently installed Foste. Wheeler units illustrating the production of asphalt from different charging stocks. B. C. A.

74. Developments in Asphalt Processing. J. E. Moul. *Refiner*, 1932, **11**, 521–522.—Describes a newly developed system of air blowing asphalt, using a mechanical device called a Turbo-Oxidiser, which induces its own air flow and disperses this air in a finely divided condition. The power consumed is claimed to be about one-fifth that required for power blowers, and where cooling is resorted to a considerably greater speed of blowing may be maintained. The device may also be used for filling asphalts with solids, asphalt emulsions and cutbacks. B. C. A.

75. Heating Asphalt with Diphenyl Vapour. W. L. McCabe. *Univ. Mich. Eng. Res. Bull.* No. 23, July, 1932.—A semi-commercial scale investigation has been made of the suitability of diphenyl vapour as a medium for heating asphalt with a view to determining: (1) whether any operating or mechanical difficulties would be experienced; (2) whether the quality of the asphalt

would be impaired, and (3) the rate of heat transfer from the condensing diphenyl to asphalt.

The advantages and disadvantages of the present direct and indirect heating systems are discussed and a summary given of the previous work on diphenyl as a heating medium for: (*a*) refining of lubricating oil; (*b*) evaporation of caustic soda, and (*c*) air preheating.

The properties of diphenyl are given, the more important being sp. gr. 1·165, M.Pt. 69° C., B.Pt. 256° C., spec. heat 0·4/0·6 between 200/700° F. latent heat 136·5 B.Th.U./lb. at the boiling point and 96·5 B.Th.U./lb. at 750° F. It is a waxy, nearly colourless material, non-poisonous and non-corrosive; it possesses a geranium-like odour and is available in large quantities at $0·17 per lb. in car load lots. A eutectic mixture of 20% diphenyl with 80% diphenyl oxide is a better carrier than diphenyl and has the advantage that it is liquid below room temperatures, thus eliminating freezing in pipelines.

The heating apparatus used consisted of a diphenyl boiler heated by fuel oil or gas, an iron asphalt heating tube 9·31 ft. long by 1 in. (and later 1¼ in.) wide in a heating jacket of standard 4 in. pipe, circulating pump, asphalt melting and weighing tank reservoir, cooler and condensate receiver and mixers. 162 runs were carried out, using: (1) saturant asphalt, and (2) coating asphalt at various asphalt velocities, temperatures and temperature drops, complete data on temperatures and rates of flow and condensation being recorded.

The following results were obtained:—

(1) After various adjustments no serious mechanical operating difficulties were experienced. It was found necessary to guard against allowing liquid diphenyl to freeze in the pipeline. This can be removed by blowing with low pressure steam or air, or if the trouble continues, by the use of the diphenyl oxide-diphenyl or naphthalene-diphenyl mixtures. Screwed pipe joints must be carefully made to prevent leakage, welded joints being very helpful. Stuffing boxes or pumps should be deeper than usual, while only moderate water cooling on the stuffing boxes is advisable if diphenyl is used.

(2) The changes in the properties of the asphalt were negligible, slight increase in softening point, fixed carbon content, and viscosity being noticed with corresponding decrease in penetration. No coking or deposition of material on the tube wall was experienced under any of the conditions, the primary effect being loss of light fractions, and probably slight polymerisation.

(3) Full data on the heat transfer coefficients were obtained and found to be reasonably consistent with existing heat transfer theories for analogous cases:—

Overall coefficient of 30/42 B.Th.U. per sq. ft. per hr. per °F.

Asphalt film coefficients of 35/50 B.Th.U. per sq. ft. per hr. per °F.

Diphenyl coefficient of 250/330 B.Th.U. per sq. ft. per hr. per °F.

Full data on the properties of the asphalt before, during and after heating are given.

The recommendation is made that the diphenyl heating system should be developed on a larger scale to enable more complete tests to be carried out.

C. L. G.

76. Second Report on the Back-Run Process for Manufacture of Carburetted Water Gas. (Institution of Gas Engineers), F. J. Dent and others. *Gas J.*, Suppl., 1932, Oct. 26, 6–9.—A comparison has been made of back-run and down-run steaming. The efficiency and rate of blue gas production and the steam raised in the generator and waste heat boilers by the two systems are discussed.

Blue gas formed during the back-run cannot be enriched with oil in the ordinary way, since carburetting is limited to the up-run. In this respect the down-run cycle has an advantage, since the supply of oil is not limited and lower rates of injection can be used. The disadvantage of the former in restricting the time of oil injection was, however, largely counterbalanced by the more uniform temperature in carburettor and superheater so that there were only small differences in efficiences of oil cracking when making gas of the same calorific value. The efficiency is greater when making gas of low calorific value. A back-run cycle, unrestricted by the time occupied by oil injection, can be used to make gas up to 450/460 B.Th.U. per cu. ft. without appreciable loss of oil cracking. When making gas of higher calorific value, a compromise must be made between possible gains in the performance of the generator and the reduction in efficiency of oil cracking through the higher rate of injection. C. C.

77. Cracking Still Gases Source of Ethylene. A. L. Migey. *Refiner*, 1932, **11**, 547–552.—The economic importance of the plastic resin industry is emphasised, and it is suggested that a new plastic resin produced commercially from ethylene will displace cellulose products, pyroxylin and phenolic resins. The cost of production will not exceed 12 cents per lb., provided the ethylene can be obtained for less than 6 cents per lb.

The advantages of this new type of resin, termed metastyrene resin are indicated and the present and future applications are traced.

To produce the best metastyrene resin the ethylene should adhere to the following specification: 98% pure ethylene, 2% ethane, absolutely free from sulphur.

Five sources are readily available for the production of ethylene, viz., natural gas, cracking suitable oils, residual gases from vapour phase cracking, cracking of liquefied gases and alcohol.

The design and method of operation of ethylene extraction and separation plants are described and it is concluded that ethylene may be produced at a cost of $3·046 per lb. B. C. A.

78. Treatment of Tar. J. G. King and M. A. Matthews. *J. Inst. Fuel*, 1932, **6**, 33–44; *Chem. Trade J.*, 1932, **91**, 365.—Foreign markets for tar are being reduced owing to increasing local production, while home supplies will probably be increased owing to the attention being paid to carbonisation processes. The 1931 production of tar in the U.K. was 1,480,000 tons, of which 850,000 tons p.a. are absorbed by the road tar market (bitumen taking 350,000 tons p.a.). The market for pitch in 1931 amounted to 310,000 tons.

Crude tar and distillates are quite satisfactory boiler fuels, but have lower calorific values and are not completely miscible with petroleum products. The use of tar distillates in the gas oil and Diesel engine oil markets are more promising, but again are not as suitable as petroleum oils. For slow speed Diesel engines difficulties in initial ignition are encountered. Removal of tar acids reduces the high S.I.T. of these oils, while the use of finer atomisation also overcomes this difficulty. If this difficulty cannot be overcome by increasing the compression ratio, the use of the distillates will be limited by: (1) pilot injection; (2) use of a special starting fuel; (3) blending with more suitable fuels; (4) use of dopes. The first two are not attractive, while the third is likely to be of limited application. Dopes, *e.g.*, ethyl nitrate in proportions of 1 to 5% give satisfactory engine performance, but add about 1d. per gallon to the cost of the oil.

The cracking of ordinary tar gives low yields of motor spirit, though better results are obtained from low temperature tars. Hydrogenation-cracking of tar, using active charcoal impregnated with ammonium molybdate as a

catalyst gave a yield of 11·6 gals. of motor spirit and 8·6 gals. of Diesel oil per ton of coal. This process also offers a method of producing toluene from naphthalene or tar acids. The cresols can be converted to toluene by passage of their vapour over a catalyst, a yield of 82% being found.

C. L. G.

79. Benzole Recovery. F. Blackburn. *Gas J.*, 1932, **200**, 565–570.—This article describes the operation of a benzole recovery and rectification plant. The wash oil is found to be most effective when its viscosity is kept below 65 secs. (Redwood I.), at 70° F., and the entire wash oil is changed once every three months. Overall production cost of rectified motor benzole is 8·697d. per gallon in this plant. W. E. J. B.

80. High Vacua in Industry. D. H. Jackson. *Chem. Met. Eng.*, 1932, **39**, 549–551.—The principles and the design of the steam jet thermo-compressor for the production of vacuum are simply explained. The use of this equipment in the petroleum and other industries is described. Some comparisons are made between steam jet equipment and mechanical vacuum pumps. G. R. N.

81. Design Calculations for Vapour-Recovery and Rectifying Units. G. G. Brown and M. Souders. *Proc. Amer. Pet. Inst.*, June, 1932, p. 9.—A critical study is given of existing formulas and methods for computing the number of plates and the proportions of columns.

While some of these have found practical application in particular cases, none of them has been found adequate as a basis for accurate design calculations for equipment operating over a pressure range up to 500 lb. per sq. in., and may lead to serious errors under these conditions.

This is ascribed to the universal assumption of the validity of Raoult's and Dalton's laws as applied to hydrocarbon mixtures when operating at pressures greater than atmospheric.

The procedure outlined in this paper avoids this assumption and, instead, is based on the assumption of ideal solutions.

It has been found to be sufficiently accurate for engineering computations, and otherwise entirely satisfactory for the design of absorption and rectifying equipment for gasoline when operating at pressures up to 500 lb. per sq. in. Examples of actual plant data are given.

The use of equilibrium constants determined on the basis of ideal solutions and the deviations from ideal gases are explained and demonstrated by numerous graphs and formulæ. S. B.

82. Selection of Materials for High Pressure and High Temperature Work in Oil Refineries. V. T. Malcolm. *Oil and Gas J.*, 13.10.32, **31** (21), 14.—The selection of alloys for high pressure, high temperature service depends to a great extent on the following characteristics: chemical resistivity, creep resistance, thermal expansion, resistance to scaling and oxidation and resistance to wear. In choosing the correct rating or alloy for equipment for a given condition, especially in the high temperature region, the rating corresponding to normal operating conditions should be used rather than the worst combination of possible extreme conditions. Design of equipment must be governed by the temperature rating, as elastic and plastic deformation are of fundamental importance. The ability of steel to withstand stress at ordinary temperature continuously is fairly indicated by conventional short-time tests, but at temperatures above 700° F. the results of such tests do not provide adequate criteria of the continuous load-carrying capacity at those temperatures. The general problem of corrosion is considered, and steps

taken to simulate plant conditions in the laboratory are outlined. The resistance to corrosion of an alloy which has a certain amount of hardness combined with toughness is greater than that of one possessing only great hardness. Tempering necessary to produce hardness must not be carried out at a temperature below the operating temperature. Thermal expansion and the stresses arising therefrom are shown to have an important bearing on the design of high temperature equipment. The use of an incorrect combination of alloys or faults in designing leading to non-uniformity of temperature distribution may considerably reduce the life of the plant. Reference is made to the work and theories of White and Clark (Univ. Michigan, Eng. Res. Bull., 1928, No. 11) in regard to the thermal and mechanical stabilities of metals and alloys. It is important to know the temperature range which is to be employed and the duration for which stability is desired, in order to determine how best to increase stability by alloying. Many alloying elements influence stability throughout the temperature range of steels to which they are added, but the effect may vary depending on the temperature under consideration. Such elements will increase the physical properties of steels, and also the purity and solidity since they induce a freedom from occluded gases. The quality of "tough hardness" which is a feature of proper alloy steel is probably due to the finer and denser structure of the constituents and to their uniform distribution, and is obtained only through the actual influence of the alloying elements in producing in the steel a condition of purity and freedom from gases.

Present A.S.A. ratings for standard flanges and other fittings are considered inadequate as they do not suggest pressure ratings for temperatures higher than 750° F. Many valves are used at temperature of 900/1100° F.,, and should the A.S.A. standard be used, at a temperature of 1000° F. the valve is very likely to fail in service. Pressure temperature ratings other than A.S.A. are therefore necessary for temperatures above 750° F. R. A. E.

83. Requirements in Materials for Valves and Fittings for High Temperature-High Pressure Field. J. J. Kanter and H. W. Maack. *Oil and Gas J.*, 27.10.32, **31** (23), 13.—In a paper presented before the A.S.M.E., Mid-Continent section, at Tulsa, the properties of steels for high temperature and pressure valves and fittings were discussed, reference being made to the considerations underlying their selection for different purposes and to the disadvantages shown by other metals.

For temperatures over 500°/600° F. cast iron is unsuitable, being insufficiently corrosion-resisting and being affected by "growth" which reduces its strength and hardness. Some alloyed cast irons show improvements in these directions, but lack ductility and shock resistance. Malleable cast iron does not grow, and retains its tensile strength and creep strength up to 750° F., but is unable to withstand strong chemical attack. Non-ferrous alloys—*e.g.*, brasses, bronzes and nickel copper compositions—are not suitable for high temperature work, losing strength and tensile and creep values after 500°/600° F. Oxidation and chemical attack considerably reduce the creep strength of these materials. Copper nickel alloys are similarly subject to embrittlement and corrosion; some have good creep strength at 600°/900° F. but tend to change in properties during exposure. For handling oil or high pressure superheated steam they are unsuited, owing to high solubility in oil vapours and the ease with which they are scored or sieze up.

Plain cast carbon steel made by either the open hearth or electric furnace process require excessive thickness to attain the necessary strength. The introduction of nickel chrome cast steel of the necessary strength and lightness required the development of a special heat treatment technique. The

addition of a small percentage of molybdenum confers more stable high temperature properties, tensile and creep strength, 0·3% Mo. raising the draw temperature to give a definite hardness from 920° F. to 1290° F., so that at higher temperatures the steel is much more stable, and does not show the rapid initial creep due to structural changes in the grain of the steel.

For bolting steels a low initial creep is essential to ensure complete tightness. Treatment of steel in the factory to complete the creep change is impracticable. Data on the tempering and drawing curves of two steels—SAE 3140—a NiCr steel and SAE 4140—a Cr. Mo. steel show that the latter required a considerably higher temper to produce a given set of properties than the former. Service tests and the high temperature characteristics of these steel indicate the superiority of the latter product.

For adequate chemical resistance towards hot oil vapour and active steam, various types of stainless and heat resisting steels have been applied with all degrees of success. They are quite satisfactory for valves, but are expensive for valve bodies and fittings. The high Cr. (12–14%) and high Cr. Ni (18–8 metal) steels are very sluggish in the molten condition, rendering the casting operations very critical, although the necessary technique has been satisfactorily worked out. Austenitic type stainless steels are prone to deteriorate suddenly under high temperature and corrosive conditions, and are difficult to machine in almost any condition. The 4–6% Cr. steels have excellent physical properties and are relatively cheap and easy to manufacture, but have lower corrosion resistance than the stainless steel proper, although they are definitely superior to low alloy products without being much more expensive. The addition of molybdenum or tungsten also improves their tensile properties at all temperatures as well as corrosion resistance and temper brittleness.

Data on the results of high temperature and creep tests on 4–6% Cr. Mo. steels are given.

For valve seatings stainless iron is perfectly satisfactory for oil and vapour control, but quite impracticable for dry steam, owing to severe seizure from the absence of lubricant. Carbon and low alloy steels are resistant to wear but not to corrosion, while non-ferrous metals—such as brass, bronze, copper, nickel and nickel copper—are not applicable to high temperature seating materials and are too soft to withstand wear in steam, and corrode rapidly in hot crude oils. The difficulties of finding a suitable metal for high pressure steam surface have been overcome by case hardening, particularly nitriding, while carburising induces rapid rust formation. Nitriding increased the hardness of steel by 3 or 5 times. It has been found that ordinary hardened tool steel tempered to over 500 Brinell is satisfactory as regards wear but does not withstand corrosion. Hardened stainless steels are very serviceable, while alloys such as stellite are particularly satisfactory.

The conclusion is reached that steel is necessary for valves and fittings for high temperature high pressure service for most applications, but for special requirements at higher temperatures, or to resist corrosion wear, alloying with other metals and special heat treatment is necessary. C. L. G.

84. Slide Rule for Gas Calculations. P. F. Marx. *Chem. Met. Eng.*, 1932 **39**, 556–557.—A slide rule has been developed to facilitate engineering calculations of such gases as air, carbon dioxide, natural gas, etc. The basis of the rule is the relation of molecular weight to the weight of the gas in lb./cu. ft., which, in conjunction with the laws of Boyle and Charles gives the data necessary to construct the scales; these are arranged so that their movement accomplishes multiplication and division of the proper constants. An example and a diagram of the rule are given. G. R. N.

88. Refinery Waste Water Recovery. A. C. Embshoff. *Refiner*, 1932, 11, 523–527.—A description of the methods of recovering refinery waste waters based on the actual experience of a refinery in Oklahoma. Composite waste water derived from a representative range of refinery plant is handled. The waste water enters a receiving sump which allows of flow equalisation and oil separation. The water is then treated with lime to raise the alkalinity followed by coagulation with alum, the precipitate from which adsorbs the suspended matter and emulsified oil present in the water. After passing through a sedimentation tank, the settled water is pressure filtered, using graded sand as a medium. The reclaimed water is used for condensing purposes and since the installation and operation of the recovery plant no water has left the refinery except by evaporation or seepage. B. C. A.

86. Still. Metallgesellschaft A.-G. E.P. 383,570, 17.11.32. Appl. 6.6.32.—A device is described for application to stills which prevents the refluxing into the distillation chamber of condensate forming on the upper walls of the still. The device comprises two bell-shaped members mounted so as to form an intermediate space communicating with the distillation chamber and filled with stagnant gas. The upper of the two members serves to collect condensate, while the lower one thermally insulates the upper from the distillation chamber. W. H. T.

87. Cracking Hydrocarbons. Vereinigte Stahlwerke A.-G. E.P. 382,355, 27.10.32. Appl. 25.8.31. Conv. (Germany), 27.8.30.—Hydrocarbons are cracked in the presence of a steel alloy containing chromium and small amounts of aluminium but no nickel. W. H. T.

88. Cracking of Heavy Oils. Akis A.-G. E.P. 383,384, 17.11.32. Appl. 24.10.31. Conv. (Germany), 31.12.30.—The oil is vaporised and passed together with superheated steam over coke in a high frequency field. The steam is decomposed into hydrogen and oxygen by electrolysis, the oxygen being directly supplied again to the oil vapours to be treated. The gaseous mixture formed may be collected for subsequent use or used immediately in a gas engine. W. H. T.

89. Refining of Hydrocarbons with Liquid Sulphur Dioxide. Edeleanu G.m.b.H. E.P. 382,556, 27.10.32. Appl. 18.4.32. Conv. (Germany), 2.5.31.—The hot vapours leaving the extract and refined oil evaporators are led to suitable contact apparatus where they are brought into contact with the extract or refined oil flowing to the evaporators. The purpose of this is to increase the contents of water and light oils in the evaporation stages of low pressure. These stages are arranged beyond the condenser pressure stage, and are constructed as drying and gas purifying apparatus. The contact devices are provided in the actual evaporators or in the domes thereof. W. H. T.

90. Inhibiting Gum Formation in Low-boiling Hydrocarbon Oils. Standard Oil Dev. Co. E.P. 383,511, 17.11.32. Appl. 11.3.32. Conv. (United States), 24.4.31.—Gum formation is inhibited by adding to the naphtha a gum inhibitor which is a dye (·002—·01% of diphenylamine with paranitrosophenol) and a colourless gum inhibitor (·01—·05% of tricresol). The amount of dye-inhibitor is sufficient to give a proper colour concentration but insufficient to give effective gum inhibition in the absence of the colourless gum inhibitor. W. H. T.

91. Treatment of Gas Carbon. W. Oostveen. E.P. 383,402, 17.11.32. Appl. 5.11.31.—The process concerns the catalytic decomposition of carbon-monoxide, methane, ethylene and acetylene into carbon. The remains of the metal containing catalyst (*e.g.*, ferric oxide) are transformed into compounds of a dark colour (*e.g.*, Prussian blue) which may be mixed with the carbon. A carbon of intense colour and of improved uniformity is thus obtained. W. H. T.

92. Reconditioning Used Oil. C. R. Mayo. E.P. 383,081, 10.11.32. Appl. 4.12.31.—The used oil collected from engine sumps, etc., flows under pressure of its own head obtained by means of an elevated storage tank into a lower compartment where the grosser impurities are allowed to settle out. This compartment is covered by means of filter cloth stretched over a wooden frame attached to the top of the compartment. When the settling compartment is full, the settled oil continues to flow upwards through the filter, into a clean oil compartment, the withdrawal of oil from which controls the rate of flow of the oil through various compartments. The rate of flow can also be controlled by the introduction of compressed air and steam heating coils. S. B.

93. Asphalt and Tar Emulsions.—Hanseatische Mühlenwerke A.-G. E.P. 382,432, 27.10.32. Appl. 2.11.31. Conv. (Germany), 1930.—This is a process for the production of asphalt and for emulsions in which an addition of phosphatides, oil containing phosphatides or their decomposition products, is employed as emulsifying agent alone or with salts of fatty acids, sulpho acids, etc. The mixture is finally saponified with ammonia, inorganic or organic alkalies. W. H. T.

94. Bituminous Products. P. Leckler. E.P. 382,842, 3.11.32. Appl. 27.2.32. —The patent relates to a method of rendering petroleum asphalt resistant to acids and of improving the drying properties. The asphalt is melted or dissolved in an inert solvent and then treated with one or more polymerising catalysts (*e.g.*, sulphuric or chlorsulphonic acids, aluminium, zinc or sulphur chlorides, or phosphorus tri or penta chlorides). The asphalt is finally washed with alkali and water. W. H. T.

95. Manufacture of Gases from Oil. J. F. L. Moeller. E.P. 382,620, 24.10.32. Appl. 24.7.31.—The oil is pre-heated to 170°–240° C. and then atomised with a jet of superheated steam at 650°–850° C. The gas mixture is passed into a retort heated to 800°–950° C. and filled with a catalytic material consisting of irregular shaped pieces of ferrous or ferric oxide. The oil is thus gasified without clogging or swelling of the catalytic mass. W. H. T.

96. Purification of Combustible Gases. G. Szigeth. E.P. 382,650, 31.10.32. Appl. 29.7.31. Conv. (Hungary), 1.6.31.—Hydrogen sulphide is removed from combustible gas by passage through a purifying plant containing a material such as ferric hydroxide. Before purification, the gas is diluted with cooled gas, free from H_2S in order to reduce the concentration of the latter below 1%. Higher concentrations than this cause an evolution of heat which interferes with the proper working of the process. W. H. T.

See also Abstracts Nos. 1, 2 and 37.

Class 700. Utilisation.

97. Compressed Gas as Motor Fuel. *Chem. Trade J.*, 4.11.32, **91**, 418.—Dr. C. M. Walter, of Birmingham, has stated that his experiments showed that compressed coal-gas gave 10% greater power than petrol and was marketable at a price competitive with petrol. Most of the difficulties of compressing gas have been solved and satisfactory engine tests completed. A test van, having a max. speed of 42 m.p.h. on petrol attained 50 m.p.h. on coal-gas. Gas consumption was 21·6 cu. ft. per mile, making about 250 cu. ft. of gas the equivalent of 1 gal. of petrol. During compression 90 gals. of a liquid motor spirit was obtained per million cu. ft. of gas. This motor spirit is stated to be better in quality than No. 1 and almost as good as aviation spirit. R. A. E.

98. Synthetic Benzine from Water Gas. A. Schaarschmidt and M. Marder. *Brenn.-Chem.*, 1932, **13** (21), 412–413.—The application of antimony pentachloride is described for the separation of saturated aliphatic and alicyclic hydrocarbons containing tertiary bound carbon atoms from benzine from water gas, whilst the normal hydrocarbons remain stable at low temperatures. Cyclopentane and cylcohexane can be obtained according to conditions. The metal chloride forms complex organo-metallic compounds with the tertiary bound carbon atoms which are insoluble in excess of the hydrocarbons or their mixtures. Two groups of hydrocarbons are formed: group (1) containing n-pentane, n-hexane, n-heptane, 2–2–dimethylbutane; and group (2) consisting of 2–methylbutane, methylcyclohexane. The hydrocarbons of group (2) react with the antimony pentachloride, and produce a brownish-yellow oil which is separable and large quantities of hydrogen chloride are evolved; those of group (1) remain in solution even at 0° C.

Extensive fractionation by means of a Dufton column of benzine obtained from water gas yielded 0·6% of n-heptane which, when treated with antimony pentachloride, gave a mixture of both groups of hydrocarbons. One-third of the hydrocarbons contained tertiary bound carbon and two-thirds of hydrocarbons unaffected by the chloride. The latter consisted chiefly of normal and quaternary hydrocarbons. W. S. E. C.

99. Town's Gas for Motors. *Gas World*, 1932, **97** (2520); *Ind. Gas Suppl.*, 13–14.—Experiments are described in which a 20-h.p. Austin van was fitted up to run on town's gas, which involved an increased weight of about 4½ cwt. The gas was stored at about 3000 lb. per sq. in. pressure in "Vibrac" steel cylinders, and reduced to a slight negative pressure by means of a special two-stage reducing valve. A special air/gas mixer, fitted with a flame arrester, was also used. The Austin van with a pay load of 15 cwt. gave a maximum speed of 55 m.p.h. and a consumption of 21 cu. ft. of gas per mile. Best ignition advance was 30°. On this vehicle 1 gallon of petrol was equivalent to 250 cu. ft. of gas. W. E. J. B.

100. Calcium Chloride in Road Making. H. F. Clemmer. *Chem. Trade J.*, 1932, **91**, 394. (From *Contract Rec. & Eng. Rev. (Canada)*.—The results of the treatment of three experimental sections of road surfaces with calcium chloride are described. The tests were carried out in localities offering widely different weather conditions and soil material, the roads being: (*a*) sand clay; (*b*) gravel road of fairly coarse material; (*c*) gravel road of fine aggregate. The object of the work was to follow the behaviour of the

calcium chloride under the effects of: (1) rainfall; (2) chemical reaction with soil; (3) maintenance manipulation.

Investigations showed that better results were obtained when maintenance was carried out only immediately after having rain or when absolutely necessary, rather than daily, which tends to loosen the surface and dissipate the calcium chloride. An important effect, beside dust laying, is the reduction of the destructive effect of freezing of the soil, as the $CaCl_2$ flocculates the soil, making it more open and permeable. It also acts as a binding agent and greatly reduces the loss of road metal. The U.S. Bureau of Public Roads has stated that the annual wear on gravel roads is equivalent to $\frac{1}{2}$ in. to 1 in. of surfacing materials or 150 to 300 cu. yd. per mile in the case of an 18 ft. road. It is estimated that the cost of using $CaCl_2$ is about equal to the cost of gravel replacement when no $CaCl_2$ is used, so that no extra expense is caused, while there is an additional advantage due to dust laying. The amount of $CaCl_2$ used should depend on the amount of traffic carried by the road, thus, for 100/200 vehicles per day 1 lb. per sq. yd. should be used and for 1000 or more vehicles 2$\frac{1}{2}$ lb. per sq. yd. The $CaCl_2$ is preferably laid in several applications. C. L. G.

161. Asphalt and Cut-Backs in the Repair and Maintenance of Roads R. W. Leslie and B. Ennis. *Oil and Gas J.*, 20.10.32, 31 (22), 13.—Modern production methods have helped to produce an asphalt of consistent quality free from the danger of overheating, but the quality of the asphalt is limited by the suitability of the crude oil.

It has been found that petroleum residues containing large quantities of wax are rendered quite suitable for the manufacture of asphalt by subjecting them to cracking, this operation destroying most of the waxy constituents. The polymerised heavy oil fractions formed during cracking also produced further desirable properties when blended with the asphalt naturally present in the residue.

The use of cutbacks in preference to residual road oils or straight asphalts is becoming widespread, mainly owing to their ease of handling and to the fact that the rate of curing and the required degree of hardness of the cured asphalt can be regulated by the choice of suitable components, whereas residual oils of similar characteristics vary considerably as far as concerns the consistency of the final product.

Bituminous macadam roads require a relatively high initial outlay but little maintenance, so that in the long run they are very economical. The asphalt normally used can be effectively replaced by cutbacks, although the layers of stone should be thinner, so as to allow of sufficient evaporation of the solvent.

In the state of Indiana the bituminous "retreat" method has been developed. The old pavement is used as a foundation (being widened and patched if necessary) for a coat of broken stone to which cutback is applied in three or more applications, following by harrowing and rolling. A cover coat of fine stone is brushed on before the final application of cutback and the road dragged to work it into the voids. When the retreat is laid on top of old gravel or sand surfaces, a priming coat of light road oil or slow curing cutback is applied to effect a proper bond. The cost usually ranges between $2000 and $3000 per mile.

The use of mixed-in-place work, where the cutback or road oil is mixed with the aggregate on the road by means of harrowing and blading overcomes the difficulty of ensuring complete coating of the stones with binder present in pre-mix work. Medium volatility cutbacks are used in order to prevent setting of the asphalt before mixing has been completed.

The surface treatment of sand-clay, gravel or old macadam roads is satisfactorily effected by a priming coat, followed by a high asphalt content slow-curing cutback with a mineral covering of ¼in. stone. The finished surface may be rolled or traffic compacted, but it is important that the foundation should be efficiently drained and that the soil has a minimum capillarity. When properly maintained a satisfactory surface at low cost is given.

The use of sheet asphalt over bituminous concrete in city streets is being extended to the lighter traffic cross country highways, owing to its cheapness as compared with concrete in localities where suitable aggregate is available.

Cutbacks are particularly suitable for general maintenance and repair work on roads, priming coats, and manufacture of all-weather runways at air ports. C. L. G.

102. Preparation of Road Surfaces with Soft Asphalt. (" Cut back " Bitumen.) Anon. *Bitumen*, 1932, **2**, 184–5.—To avoid the use of hot bitumen, the latter is fluxed by the addition of suitable mineral or tar oils, and mineral aggregate is coated with this " cut back " bitumen at a temperature of 60–80° C. A second method consists in first wetting the mineral aggregate with a suitable oil and then adding a bitumen of satisfactory grade at 120–150° C. The proportion of binder varies with the size of the stone, and this, in turn, depends on the purpose for which it is to be used.

An outline is given of the use of this material for road surfacing. C. C.

103. Use of Bitumen for Concrete Protection. F. Greger. *Bitumen*, 1932, **2**, 151–156.—A survey is given of various proposals which have been put forward from time to time for standard tests on these materials.

The views of Grun [Tonindustrie-Zeit. (70) 1927 and (19), (39), (40), 1929], Rick (Ibid. (101), 1927) and Hutzenlaub are outlined. More recently the Deutsche Reichsbahn-G.m.b.H. has issued a series of tentative tests. Materials which are fluid in the cold and those which require heating are differentiated. The tests include: bitumen content, softening point, drying power, bending test after heating and cooling, covering power, water-tightness and resistance to chemical action. All the tests are not necessary for every kind of material (*e.g.*, the first coat should fill up the pores of the concrete surface and form a suitable groundwork for the succeeding coats. Covering power and water tightness are less important in this case).

The bitumen should contain no tar or added mineral matter. The various tests are described, the details varying with the purpose for which the material is to be used. The chief use is in protecting buttress-breast and pinion walls, brick or iron bridges and reservoirs. Certain sources of ultimate trouble in the preparation of the concrete surface are indicated.

For the first coat a solution of bitumen in benzine, benzole, solvent naphtha, etc., is generally used, as this has good penetrating power and forms a good undercoat for a second application of hot material. Dry weather and a thoroughly dry surface are necessary for the satisfactory application of these materials. To obviate this difficulty the use of bitumen emulsions has been proposed, but the latter have not come up to expectations. Bitumen solutions adhere better and dry much more quickly. Emulsions are unsuitable for strongly inclined or vertical surfaces, but can be used for level surfaces providing that at least 2 or 3 days elapse before the second coating is applied.

Water soluble emulsifiers may affect the adhesion of the bitumen, but resinous emulsifiers improve this property.

If the bitumen coating is to remain durable and effective, it must be protected as soon as possible after hardening, usually by a layer of stone material (40 cm) thick in the case of buttresses. C. C.

104. Some Aspects of Boundary Lubrication by Soap Solutions. R. C. Williams. *J. Phys. Chem.*, 1932, **36**, 3108. The effect of sodium and ammonium soaps in producing lubrication during wire-drawing through a specially designed apparatus has been studied. The effective lubricating properties of sodium and ammonium soaps solutions was due to the products of hydrolysis, namely, fatty acids or acid soap. By sufficiently repressing the hydrolysis of the soap solution, lubrication was considerably diminished, becoming ultimately negligible. When tallow was emulsified in a soap solution lubrication was not appreciably affected at either low or high p_H values.

No parallelism existed between the lubricating effectiveness and the surface tension of the soap solutions when the p_H value was varied, but as the concentration of a given soap solution was decreased to a point in the vicinity of that at which lubricating effectiveness diminished rather sharply, the surface tension increased.

There was some indication that the degree of peptization of the fatty acid or acid soap was a factor in lubrication of wire by soap solutions.

H. E. T.

105. Insecticidal Studies of Mid-Continent Distillates as Bases for Pyrethrum Extracts. H. H. Richardson. *Ind. Eng. Chem.*, 1932, **24**, 1394. Attempts have been made to determine which fractions of Mid-Continent distillates are the most effective for use in the preparation of pyrethrum extracts. The distillates were first tested alone and then in the form of extracts prepared with these distillates. The tests were carried out in a standard manner on batches of 40-50 house flies, the time (in seconds) for 50% of the flies to become paralysed being determined. Distillates in the higher boiling range, 192°–269°C., were found to be the most toxic. Shorter cut fractions (203°–260° C.) were found to be equally efficient as the longer cuts, but it is pointed out that the latter should be more suitable from an industrial standpoint. SO_2 refined distillates show little difference in insecticidal effect from those refined by normal methods. The long-range distillate which was the most efficient when tested alone also gave the most effective extracts.

W. H. T.

106. Domestic Liquid Fuel Burning Mechanism. W. W. Triggs (from Williams Oil-O-Matic Heating Corporation). E.P. 382,653, 31.10.32. Appl. 29.7.31.—The mechanism comprises a motor on which an end bell is mounted, the bell carrying a mixing pump. The latter has inlets for liquid fuel and air, and means for discharging and controlling the fuel mixture under pressure to the burner nozzle. W. H. T.

107. Oil Vapour Burners. F. Tyers. E.P. 382,675, 3.11.32. Appl. 29.3.32.—Oil is passed through a vaporising coil, the turns of which form an interior space of the same shape in plan as that of the flame. One or more outlet jets are arranged below the coil, the top of which is provided with a cover plate. The latter has a long narrow slot whereby the shape of the flame can be controlled, the whole of the flame passing up through the coil and out through the slot in the cover plate. W. H. T.

108. Heavy Oil Burners. S. A. le Carbone. E.P. 383,440, 17.11.32. Addition to 346,963, 19.11.29. Appl. 1.12.31. Conv. (France), 16.1.31.—The invention relates to burners in which the fuel traverses by capillary attraction or by pressure, a mass of activated carbon and thereby is transformed into lighter and more inflammable products.

The carbon is formed from a woven fabric or entangled mass which is rolled round a support in the form of a rod. W. H. T.

109. Disinfecting and Insecticidal Agents. S.A. Mines d'Orbagnoux. E.P. 384,151, 1.12.32. Appl., 16.3.32. Conv. (France), 13.6.31. The insecticide is formed from the sulphonation product of a mineral oil by treatment with a hydroxy acid or a salt thereof or a poly hydric alcohol in the presence of a suitable metallic salt and of an alkali. The relative proportions of the products used are calculated such that the quantity of metallic salt corresponds at the most to the amount necessary to form the sulphonate of the metal, that the proportion of hydroxy acid or polyhydric alcohol to the metal is the minimum necessary for solution, and that the final reaction is neutral or feebly alkaline. W. H. T.

See also Abstract No. 53.

ABSTRACTS.

Class 100. Geographic Occurrence.

110. International Asphalt Statistics, 1929/1930.—W. Schmidt. *Bitumen*, 1932, 2, 169-174. Statistics are given for the asphalt industry covering practically all parts of the world. The first part of the paper deals with production. A series of tables gives: (1) the world production of natural asphalts and bitumen for 1929 and 1930 for individual countries in America, Europe, Asia and Africa; (2) the percentage of the total of these products in the four continents; (3) the percentage of bitumen used for road manufacture, tar-felt and other purposes in the U.S.A. for 1928-1930, and (4) the production of asphalt in Germany.

World imports and exports of asphalt in 1929 and 1930 for various countries in the five continents are given in further tables and finally the destination of exports from Germany in 1925—1931. C. C.

111. Analyses of Crude Oils from Oklahoma City Field, Oklahoma. E. L. Garton, U.S. Bur. Mines, Repts. Invest. 3180, Oct., 1932.—The discovery well in this field was completed at a depth of 6402 ft. in December, 1928. In April, 1932, there were 866 wells producing in the field and many locations remain to be drilled. Detailed analyses of 21 samples are given. Excluding three of the samples, which are regarded as not typical, the average properties of the crude produced in the field are: A.P.I. grav., 38·7°; sulphur, 0·17%; visc., S.U. at 100° F., 39/47 secs.; pour point, ranging from below −5° F. to 30° F.; gasoline and naphtha content, 24·8/35·5% with an average of about 28·8%. According to the classification of Smith and Lane, all of the samples are either of the "paraffin" base or the "intermediate" base type with the former preponderating. Due to the similarity of the general properties of the various crudes in this field, the production from the many wells is handled collectively on the commercial scale, and priced on a gravity basis. Oils from the Oklahoma City field are similar to those produced in the Seminole field except that they contain slightly less gasoline and naphtha, and have lower sulphur contents and carbon residue values. R. A. E.

112. Geology and Possibilities of Oil N.E. of the Defined E. Texas Field. L. Decker. *Oil and Gas J.*, 5.1.33, **31** (33), 12.—Structurally, the E. Texas field lies on the western flank of the Sabine uplift, where the sediments of the Tyler Basin, Eocene and Cretaceous in age, begin to pinch out against the slopes of this ancient land mass. Of these formations the Woodbine is, commercially, the most important. It was laid down unconformably on the shores of the Sabine land mass during a gradual stable subsidence of the latter, so that it is overlapped, successively, from the centre of the Tyler Basin eastward, by increasingly younger beds. Throughout this period, minor oscillations of the shore-line resulted in a marked lenticularity of the formation.

The structure of the defined field is that of a monocline, with production from the Woodbine sand some distance down dip from its pinched out eastern limit. The evidence furnished by the trend of a distant outcrop of the producing formation, and by well-logs, indicates a continuation of the sand in a north-easterly direction, accompanied by similar shore-line conditions. The author discusses the possibilities of four structures in this area. Three of these are of the same type as the main field, in that closure is furnished

on the north and south by the flanks of gentle folds running at right angles to the general strike of the area, and on the east by the pinching out of the producing formation. The fourth is situated further down dip, and any production will be the result of simple anticlinal accumulation only. The author considers prospects in these areas to be favourable, though accumulation may be modified by variations in sand porosity. A. L. G.

113. Origin and Microfossils of the Oil Shale of the Green River Formation of Colorado and Utah. By Wilmot H. Bradley. *U.S. Geol. Surv. Prof. Paper*, 168.—The Green River formation, of Middle Eocene age, consists of a series of lacustrine sediments, averaging 2000 ft. in thickness and containing numerous oil-shale beds. The distribution, appearance and mineralogy of these beds are discussed, and a study is made of sedimentary structural features which suggests two extreme conditions under which they were formed. Thus the regular beds of great persistence indicate relatively deep, thermally stratified waters, of which the lower stagnant layer was favourable for the accumulation of organic ooze, while the lenticular beds suggest stages of low water level and accumulation in residual pools.

The microfossils of this formation occur locally in beds of rich oil-shale and in chert concretions. They include many fungi spores, a number of forms of algæ, abundant spores and pollens of mosses and ferns, and a few remains of higher plants. The fauna of the oil-shale comprises rhizopods, insects and a mite. The structureless organic material, which closely resembles that of certain modern lacustrine oozes, appears to have been formed by the partial decomposition of (chiefly) indigenous micro-organisms. After the reduction of this material to a gelatinous condition, further bacterial decay appears to have been arrested, shown by the preservation, as in amber, of organisms subsequently entombed therein.

The ancient Unita Lake, in which the Green River formation was laid down, seems at first to have been shallow, relatively stable and fresh. Later, it fluctuated considerably in level, became warm, and rich in foodstuffs, resulting in flourishing aquatic life; this was followed by a saline phase, less favourable to organisms, and finally a return to fresh-water conditions. Several maps and sections accompany the paper. A. L. G.

114. Hot Water Separation of Bitumen from Alberta Bituminous Sand. K. A. Clark and D. S. Pasternack. *Ind. Eng. Chem.*, 1932, **24**, 1410.—An apparatus and procedure is described for determining the yield of bitumen in laboratory-scale hot water separation of bituminous sand. The plant consists of a machine for heating and mixing the bituminous sand with water, the mixture being subsequently discharged into a feed hopper and screw conveyer. The latter exhausts into a separation box which forms part of a hot water circulation system. A sand pump removes water and sand from the bottom of the separation box into a "tailings" settling cone, from which water is withdrawn, reheated with steam and recirculated. An examination has been made of the effect of acidity or alkalinity and the presence of various salts, hydroxides and clays in bituminous sand on the efficiency of separation. Acidity in the sand must be first neutralised before washing with hot water is effective, all the alkaline compounds of sodium, potassium and ammonia appearing to serve equally well as neutralising agents. Calcium and magnesium hydroxides were found to be detrimental, but corresponding amounts of the carbonates caused no harm, although when in excess a large proportion was retained by the bitumen. The result of washing with sodium hydroxide was the production of the corresponding calcium and magnesium salts, the latter affecting separation

adversely. Using sodium carbonate, however, calcium and magnesium carbonates are formed which are not detrimental in small quantities. Iron salts did not affect separation very badly, but sodium sulphate increased dispersion. Clay affected separation adversely, and is indicated as the most troublesome impurity in bituminous sand from the standpoint of commercial operations. W. H. T.

115. Expansion in Canadian Refining Operations. C. O. Willson. *Oil and Gas J.*, 3.11.32, **31** (24), 8.—With the construction of three small plants during 1932 and the completion of two larger refineries under way, Canada will shortly be not only self-supporting but will be able to play an important part in world markets. Improvements in existing refineries have been made, and the construction of at least two further large refineries is being considered. It is expected, however, that the abolition on October 20, 1932, of the dumping duties on gasoline will retard expansion to some extent, although the economic conference at Ottawa will probably increase the export trade of Canada with the Empire.

It is pointed out that the demand for gasoline varies with the seasons much more than in the U.S.A., necessitating shutting down and storage of gasoline during the winter or having excess refinery capacity to cope with the summer demand. Owing to the sparse population, the demand for petroleum products is largely centred in a small section of the country (Toronto and Montreal are the chief centres). Thus the market for heavy residual fuels is confined largely to the marine bunker trade, so that if the refinery is in the west the transportation of the fuel must be considered. In this connection transportation by water is an important feature. Coal is very cheap in Canada, so that the development of outlets for fuel oil in industry is limited, while the climate demands a fuel with a very low cold test. The availability of cheap electricity, even for steam raising and farm requirements, limits the demand for fuels and kerosine.

There is a large demand for kerosine and special distillates for farm tractors, but the market is very widely scattered.

Although natural gas is a competitor in some parts there is a very large potential market for furnace oils.

The Imperial Oil Refineries, Ltd., which possesses more than 50% of the entire refinery capacity in Canada is the only refiner of lubricating oils and wax.

The gasoline marketed generally in Canada is of high quality, the largest companies selling an octane 71 gasoline with a low distillation range.

The Canadian production of crude oil supplies only a fraction of the total requirements, the main supplies coming from the Mid-Continent, Californian or South American fields.

Tables are given showing the refinery production, imports, exports and domestic consumption, with some details of the refineries operating in Canada. C. L. G.

Class 200. Geology and Origin.

116. Origin and Occurrence of Petroleum in the Earth's Crust. D. Preda. *Ann. Min. Roum.*, 1933, **16**, 7—10. The author deals with the process of the formation of petroleum as propounded by the modern organic theory. The supposition that the mixture of hydrocarbons composing this substance is derived from marine organisms is shown to be supported by conditions in the seas of to-day, and by geological evidence of such conditions in the past. Only in special circumstances, however, does this material ultimately become

petroleum; deposition must occur in shallow seas, or those separated from oceans by shallow bars. Here the upper waters are well oxygenated, supporting abundant life; but at the bottom, reducing conditions and a high salinity prevent the total decomposition of the organic matter which sinks from above. Such accumulations form the mother-rock, whence petroleum is forced by subsequent compaction, filling vacant spaces in the adjacent rocks. Either the fissures of a limestone or the inter-granular spaces of a sand may serve this purpose. Later, orogenic movements, by developing lines of weakness, may result in migration to other porous rocks situated in regions of less resistance. Finally, when a state of equilibrium is attained, accumulation occurs, most commonly along the axes of anticlines, or of fault zones. A. L. G.

Class 300. Development and Production.

117. Cements and Well Cementing: Effect of Chlorides on the Setting and Hardening of Cement. A. Reid and J. T. Evans. *J. Inst. Petr. Techs.*, 1932, **18**, 992—1006. Experiments on the effect of sodium chloride on the tensile strength and setting time of cement under various conditions are given. The application of the results to well cementing is indicated. G. R. N.

118. Practical Benefits of Pressure Maintenance in Petroleum Production. W. N. Lacey. *Oil Weekly*, 9.1.33, **68** (4), 19—27. Gas used in pressure maintenance projects is present in two ways, firstly, in contact with the liquid oil, and secondly, dissolved in the liquid.

When gas pressure is increased or when the temperature is decreased the solubility of gases is increased and this increase of solubility is under most circumstances proportional to the increase in gas pressure. The extent of solubility of a gas in a given liquid cannot be predicted without experimental data.

Since composition of the oil affects the solubility of a given gas, variations in gas composition become important. From experiments carried out it was seen that the heavier gases are much more soluble than methane, indicating than the composition of mixed gases has a very great effect upon the extent to which solution will take place, and this indicates the greater value of rich gas for repressuring purposes as compared to dry gas.

High surface tension has caused difficulty in removing the oil from the small capillaries and a decrease in this property would therefore be of value. The dissolving of gas has a marked effect on surface tension.

Similarly, dissolving gas lowers the viscosity and this means an increase in mobility.

Dissolved gas has an effect on the volume of oil and this increase in volume has an important bearing upon the calculation of oil reserves underground.

The rate of solution has been determined and a table is given for a few different gases.

The data obtained from the experiments carried out indicate that:—(1) Natural gas dissolves in crude oil in substantial quantities and the amount dissolved is somewhat greater for high gravity oil than low gravity oil and is much greater for wet gas than dry gas; (2) viscosity and surface tension are greatly lowered by dissolved gas; (3) the volume of the oil and the A.P.I. gravity are increased by dissolved gas; (4) gas saturates oil very slowly except in relatively thin layers, so that it is desirable to maintain original pressures and so avoid release of dissolved gas. L. V. W. C.

119. Hydrodynamics of Reservoir Drainage and its Relation to Well Spacing. H. D. Wilde, jr., and T. V. Moore. *Oil Weekly*. 5.12.32, **67** (12), 34—40. When a well punctures an oil reservoir a region of low pressure is created and liquids and gases will tend to flow from higher pressure regions. This flow will result in a reduction in pressure, the extent depending upon the gas-oil ratio and also upon the nature of the oil and gas. Any control which tends to make the gas expand or edge water intrude evenly will increase the yield from the well. Where a number of wells are drilled into a field the low-pressure areas around each well will expand, and when these areas meet the phenomenon of interference occurs. Even with a proper well spacing some interference will be called for.

The problem may be classified into a number of phases, such as the Flow of simple fluids through Porous Media, the pressure gradient about Oil or Gas Wells, etc.

The second part of this paper deals with a mathematical survey of the Equations for Steady Flow of Simple Fluids. L. V. W. C.

120. U.S. Patents on Drilling Apparatus.—J. Johnson. U.S.P. 1,885,266, 1.11.32. Rotary drill.

R. D. Phillips. U.S.P. 1,885,623, 1.11.32. Mechanical device for unscrewing fish in well.

J. J. Conroy. U.S.P. 1,886,167, 1.11.32. Casing head construction.

A. E. Carlson. U.S.P. 1,886,789, 8.11.32. Reamer.

R. E. Lee. U.S.P. 1,886,820, 8.11.32. Drilling tool for lateral and angular drilling.

J. A. Zublin. U.S.P. 1,887,746, 15.11.32. Fluid control for pneumatic oil lifts.

M. T. Archer. U.S.P. 1,887,865, 15.11.32. Multiple casing head construction in which each casing head is equipped with means for varying the compression of its own gland packing.

G. H. Straatman. U.S.P. 1,887,907, 15.11.32. Apparatus for surveying wells.

W. J. Hart. U.S.P. 1,888,125, 15.11.32. Paraffin liquefying device.

L. L. Hazin. U.S.P. 1,888,126, 15.11.32. Jar for drilling tools.

S. E. Manning. U.S.P. 1,888,405, 22.11.32. Method and apparatus for setting screens.

W. L. Church. U.S.P. 1,888,550, 22.11.32. Control head.

A. B. Edwards. U.S.P. 1,888,588, 22.11.32. Pump tubing protector.

J. S. Abercrombie. U.S.P. 1,888,814, 22.11.32. A method for drilling wells utilising a slip joint drive coupling which includes a housing, a drive bushing and a drive stem, the housing and stem having relative longitudinal movement.

H. E. Dennie. U.S.P. 1,889,059, 29.11.32. A casing protector of resilient material with a stiffener placed at its inner surface in a lengthwise direction.

J. A. Francis. U.S.P. 1,889,283, 29.11.32. Rotary jar.

J. L. Thomas. U.S.P. 1,889,503, 29.11.32. Rotary type float valve.

E. H. Campbell. U.S.P. 1,889,772, 6.12.32. Device for formation testing and well flowing.

B. S. Minor. U.S.P. 1,889,787, 6.12.32. A device for controlling pressures in oil wells.

M. J. McNulty. U.S.P. 1,889,808, 6.12.32. System and apparatus for elevating and lowering oil well piping.

G. W. Miller. U.S.P. 1,889,865, 6.12.32. Clean out bit for sand pumps.

G. A. Montgomery. U.S.P. 1,889,866-73, 6.12.32. Tool joints.

G. H. Ennis. U.S.P. 1,889,889, 6.12.32. Placing body of electrolyte between layers of drilling mud, bailing out the mud from above to allow water to enter and then to electrochemically test the electrolyte to determine whether it has been diluted or not.

J. J. Jakosky. U.S.P. 1,889,921, 6.12.32. Apparatus for measuring deviation of rotary drills from the vertical.

J. J. Santiago. U.S.P. 1,890,022, 6.12.32. Hole straightener consisting of a guide tube, which is just slightly smaller in diameter than the hole being drilled, placed around the drill pipe with passage permitting the flow of drilling mud.

J. E. Kilzer. U.S.P. 1,890,223, 6.12.32. Drill pipe float coupling.

S. V. Hite. U.S.P. 1,890,607, 13.12.32. Depth indicator and inclinometer.

E. J. Le Compte and C. A. Harrisson. U.S.P. 1,891,328, 1,891,329 and 1,891,330, 20.12.32. Rotary oil well drilling apparatus.

G. H. Bowlus. U.S.P. 1,891,401, 20.12.32. Oil well surveying device.

I. C. Irving. U.S.P. 1,891,416, 20.12.32. Well drilling machine using combination of rotary and percussion systems.

O. K. Stephens. U.S.P. 1,891,508, 20.12.32. Casing hanger for suspending and packing strings of casing.

C. R. Nichols. U.S.P. 1,891,628, 20.12.32. Method of determining angle and direction of dip of geological formation.

R. H. Carr. U.S.P. 1,891,667, 20.12.32. Method for facilitating the flow of wells.

R. F. Parks. U.S.P. 1,891,832, 20.12.32. Elevating and rotating device for oil well pipe.

N. W. Wilkersham. U.S.P. 1,892,442, 27.12.32. Slip mechanism.

H. Pennington. U.S.P. 1,892,517, 27.12.32. Well drilling apparatus.

L. V. W. C.

121. U.S. Patents on Crude Oil. F. F. Gorman. U.S.P. 1,886,008, 1.11.32.—Paraffin deposition from crude oils is prevented by the addition of a mixture containing gas oil, soda ash, sodium bicarbonate, sodium hydroxide and naphthalene.

G. H. Meinzer. U.S.P. 1,887,774 and 5, 15.11.32. Dehydration of crude oil by upward passage through a gently agitated layer of solid granular material or between oppositely disposed surfaces, one preferentially wetted by water and the other by oil.

W. B. Lerch. U.S.P. 1,890,789, 13.12.32. Emulsions of oil and water are broken by the addition of a demulsifying agent. The latter is obtained by the reaction of a sulphonated vegetable oil with a material formed by chlorinating hydrocarbons of the polyolefine, cyclopentene or cyclohexene series.

J. B. Jennings and G. P. Estes. U.S.P. 1,891,987, 27.12.32. Water and B. S. are removed from crude oil by addition to the latter of a mixture containing 25% castor oil, 15% spirits of nitre, 10% common salt and 50% gasoline.

W. H. T.

Class 400. Transportation, Storage and Distribution.

122. Protection of Gas Lines from Corrosion. J. H. Dameron. *Petr. Eng.*, Oct., 1932 (4), 1, 46.—Unusual features of construction and protection for both buried and exposed pipe were adopted by a Californian gas company for a new 80-mile line from Huntingdon Beach to San Diego.

A soil survey was made using Shephard Earth Resistivity Meters, taking readings at locations 600 ft. apart, at depths of 15 in. and 30 in. Coatings were applied where the resistivity was low, and the line laid bare where it was 10,000 ohms or more. Two types of coatings were applied: (1) a coating applied in the field consisting of a coal tar primer over which two coats of coal tar enamel with a melting point of 300° F. were applied. After cooling, the line was wrapped with asbestos felt paper; (2) a coating applied in the warehouse yard consisting of an asphalt primer, hot coat of blended asphalt rag felt wrapper, another hot coat of blended asphalt, followed by another rag felt wrapper and finished off with an application of Kraft paper. Further protection is afforded by the provision of electrical drainage for currents induced in the pipe line, thus keeping the potential of the coated pipe below that of the surrounding soil. The operating expense of the electrical protection is estimated at $7·70 per year per mile of pipe. For submerged and bridge type of stream crossings galvanised pipe with welded joints coated with molten zinc with spray guns were used.

Details of the type of line laid and of the welding and laying operations are given with statistics as to the capacity of the line, etc. This line represents an investment of $1,000,000, and from the standpoint of corrosion is believed to be one of the best protected of any line running through terrain with long sections of highly destructive soil. C. L. G.

123. Pipe-Line Protection. S. Gill. *Ind. Eng. Chem.*, 1933, **25**, 49.—The present position of pipe-line protection is reviewed by the author, and the conclusion is drawn that, although there are coating systems which can be relied upon to reduce corrosion of buried lines, all are subject to certain objectionable features.

The requirement of impermeability to moisture is stressed, and the factors influencing this property are: (1) chemical or bacterial action; (2) capillary pores, and (3) mechanical distortion (soil-stress action).

Pipe coatings are considered under the following headings: (1) oil paints; (2) bituminous "cut-backs"; (3) asphalt emulsions; (4) greases; (5) lacquers and synthetic resins; (6) molten bitumens; (7) pipe-line wrappers; (8) bituminous mastics; (9) Portland cement coatings, and (10) vitreous enamel. In general, the first three methods are considered unsatisfactory on the ground of permeability to moisture. Greases may provide protection in swamps where the soil pressure is low, but are only of general use when combined with an impervious wrapper. Despite the absence of extensive field tests of coatings of the lacquer type, the author considers that this type of coating offers great possibilities in the future as being inexpensive and easy to apply under field conditions. Molten bitumens with suitable wrappers provide good protection, and wrapped enamel coatings in particular are considered to possess greater protective value than any currently available coatings of comparable cost. Bituminous mastics provide satisfactory protection, but difficulties of application may limit the use of these materials. Experience has shown that cement mortar, properly applied, will afford lasting protection against soil corrosion, but the operation is normally costly and does not allow of the salvage of abandoned pipe at an economical figure. Recent work appears to be eliminating the objection due to high cost. No data on field tests with vitreous enamel as a coating are available, but the method is regarded as possessing considerable possibilities. E. N. H.

124. Pipe Joints. J. Ruscoe & Co. and G. H. Kenyon. E.P. 383,751, 24.11.32. Appl., 1.12.31.—In making branch connections to fluid mains under pressure, a hole is drilled in the main by a ferrule inserting machine, which is clamped around the main and provided with a valve through which

the tool operates. By this arrangement, difficulties are experienced in making a tight joint between the ferrule inserting machine and the pipe. To overcome this difficulty, a sleeve is inserted in the aperture in the machine through which the drill passes, the end of the sleeve making contact with the surface of the pipe. A ring of jointing material is arranged between the end of the sleeve and the surface of the pipe to prevent leakage. W. H. T.

125. Insulating Roofs for Storage Tanks. B. Lentschewsky. E.P. 383,152, 10.11.32. Appl., 21.3.32. Conv. (Germany), 24.3.31.—The roof consists of a number of rectangular cells or floats which are superimposed in diagonally staggered relation. The edge of each unit so formed is stepped or rebated, and allows the edges of adjacent units to bear on each other. Auxilliary gravitational or spring means may be provided for tending to separate the floats. Supplementary floats with one side curved are included to conform to the curvature of the tank sides. S. B.

Class 500. Properties and their Determination.

126. Total Heats and Specific Heats of Petroleum Waxes. C. M. Gateley. *Fuel*, 1932, 12, 26.—The total heats of nine waxes have been measured from their m.pt. to 300° C., by employing Regnault's method. The waxes consisted of four fractions of Persian wax, ranging in m.pt. from 106° to 145° F., three fractions of Burmah wax ranging in m.pt. from 123° to 145° F., and samples of white ceresine and refined natural yellow ozokerite. To the total heat-temperature curves obtained equations were fitted, while the experimental results and the mean specific heats calculated from these equations were in good agreement, the average deviation being about 0·1 to 0·2%.

The total heat-temperature curves were all of a parabolic form, namely, $H = at + bt^2 + c$, where H is the total heat, a, b and c being constants; the total heat at the temperature at which the wax completely melted being assumed to be zero. The specific heat-temperature curve is thus linear and the temperature coefficient of specific heat is given by 2 b.

All the waxes had the same coefficient $9{\cdot}0 \times 10^{-4}$ per °C, this being in agreement with the work of Schiff and others that the effect of temperature on specific heat is the same for organic liquids of the same chemical nature. Taking the average value of a found from the experimental results as being 0·492, the specific heat of petroleum wax can be represented with sufficient accuracy by the equation: $S = 0{\cdot}492 + 0{\cdot}0009\,t$ (° C.). H. E. T.

127. Viscosity and Lubricating Value of Oils. E. Lederer. Reprint, I.P.K., No. 18,664, *Petr. Zeit.*, 7.12.32, **28** (49). *Motorenbetrieb*, **5** (12), 1-10.—A review of the work of various chemists on this subject is given and numerous formulæ are quoted, showing the relationship between viscosity and temperature and other physical properties of lubricating oils.

As a result of the research carried out it is concluded that the function of the viscosity dilution is distinctly different for fatty and mineral oils due to the higher solvation activity of the former. The dissimilar constitutions of the oil molecule explain the different effect in semi-liquid friction and this fact is supported by optical observations.

Thermodynamic principles are verified for the dependance of viscosity on temperature and for the viscosity of mixtures. The energy of association is found to be much greater for such mixtures than for pure liquids. The empirical Walther's formula for the viscosity/temperature function is

discussed, and an equation is derived for determining the viscosity of the components of the mixture.

The solvation activity for hydrocarbons may be determined, but in case no solvation effect is observed, there is a possibility of a viscosimetric determination of the molecular weight of lubricating oils. The formulæ for the determination of the viscosities of mixtures is discussed with regard to the solvation activity and the heat of reaction, if any, is calculated.

W. S. E. C.

128. Laboratory Method for Determining Performance of Extreme Pressure Lubricants Now in Use. H. R. Wolff and H. C. Mougey. *Oil and Gas J.*, 17.11.32, **31** (26), 58.—The authors report progress made since the paper by Mougey and Almen (Abstr. No. 28, 1932). Sulphur and chlorine are the most effective additive agents in use at present. Lead soaps require the addition of free or loosely combined sulphur in order to be effective, and they tend to precipitate from the oil and to form a lead sulphide sludge with the sulphur present. Reference is made to a number of laboratory testing machines which have been proposed, and the fallacy of accepting such machines as a primary standard for evaluating lubricants is pointed out. Performance in actual service must be the primary standard, and the test method standardised in terms of primary service data. However, it is difficult to obtain such data at present, since few automotive manufacturers are marketing products which require extreme-pressure lubricants. The large machine described by Mougey and Almen was found to give unsatisfactory correlation, and a new one has been designed which is portable and less expensive. This is known as the "Almen Extreme-Pressure Lubricant Testing Machine," and several models have been built and are being used by members of the S.A.E. Lubricants Research Committee for research work. A description is given of the machine and of the operating conditions which appear to give the best correlation against service data on rear axles employing steel on steel spiral bevel or hypoid gears. Analyses of a number of extreme pressure lubricants are quoted, and results are given of actual service tests which were carried out on many of them in cars and trucks of current production. Practically all such lubricants will oxidise and thicken when high temperatures are encountered. The copper strip test is shown to be useless as an indication of corrosive properties of the lubricant in use. Two instances of corrosion when using sulphur chloride extreme-pressure lubricants are reported and believed to be due to contamination with water in service. The co-operation of the petroleum and automotive industries is required in order to solve the related problems of gear development and extreme-pressure lubricant manufacture.

R. A. E.

129. Engler Viscometer and the Theory of Laminar Flow at the Entrance of a Tube. L. Schiller. *J. Rheo.*, 1932, **3**, 212-216.—In an earlier publication, Erk (*J. Rheo.*, 1931, **2**, 163) stated that the relationship between kinematic viscosity and Engler degrees is adequately represented by Vogel's empirical equation, and that the theoretical equations of Mises and of Schiller departed appreciably from experimental values.

Schiller draws attention to an error made in the derivation of his approximate equation for high viscosities (*Zeit. angew. Math. Mech.*, 1925, **5**, Sect. 7, 111). Further, he utilises his theory for laminar entrance-flow (*Forschungsarbeit, V.D.I.*, Heft 248, 1922; *Zeit. angew. Math. Mech.*, 1922, **2**, 96) to derive equations which may be converted into a kinematic viscosity-time of efflux equation. By plotting this theoretical equation on a kinematic viscosity-time basis, he demonstrates its general agreement with the Vogel equation, similarly plotted. The discrepancies which exist are explained on theoretical grounds, chief among which is that the course of

the theoretical curve is relatively sensitive to changes in the dimensions of the instrument. An error of 0·03 mm. for instance in the diameter of the Engler instrument causes an error of 2·5% in E°, which is of the same order of magnitude as the discrepancies between the theoretical and Vogel curves. C. I. K.

130. Approximate Calibration of Apparatus for Measuring Absolute Viscosity. C. H. Weiss and M. Louis. *J. Rheo.*, 1932, **3**, 217–220.—Whilst water, among other liquids of known viscosity, is employed to calibrate viscometers of the Ostwald type, the capillaries of those instruments most useful to the oil industry are too large for direct calibration with water. This creates the necessity for viscous standardising liquids whose absolute viscosity can be determined by the authors' "absolute" instrument (*Bull. Soc. Francaise de Physique*, 1931, p. 64). By taking certain precautions the determinations agree within 0.5%.

They have also described the calibration of a relative viscometer of the Ostwald type (Congress of Lubrication, Strasbourg, 1931), and these experiments led to the introduction of a new "Baume-Vigneron" type of instrument. The absolute viscosity is calculated by the equation $=K(P—hd)t$, when K = calibration constant, P = the suction pressure raising the liquid, h = the counterpressure (height of liquid) exerted by the liquid, d = the density and t = the time taken to fill the viscometer bulb.

Calibration therefore consists of evaluating h and K. The constant h apparently can be determined to within 0.5%. The estimation of the value of K, however, involves the use of a viscous liquid, the viscosity of which also can be obtained to within approximately 0.5%. Hence K ought to be known to 1%.

Experiments were carried out to verify whether K could be determined consistently to within 1%, and it was found from fifty results that the variation in K values was about 2% for one oil (semi-fluid) and somewhat greater for a semi-heavy oil.

The difficulty is the identification of the probable source of error which the authors believe is connected with the variation of viscosity with temperature, and the low heat-conductivity of mineral oils; that is, if the uncertainty is that the mass of a thick oil varied in its temperature by 0.1° C., the 1% error would be immediately explained. The authors solicit answers to the queries: (1) Have others been led to suspect standard liquids in limiting the precision in the calibration of viscometers? (2) Have they adopted other standards that are free from such objections and at the same time have the same qualities (stability) as oils? C. I. K.

131. High-Pressure Capillary Flow. M. D. Hersey and G. H. S. Snyder. *J. Rheo.*, 1932, **3**, 298–317.—The paper deals with the flow of liquids through capillaries under inlet pressures which are so high that the viscosity cannot be assumed to be uniform throughout the length of the tube. Having anticipated the fact that the viscosities of lubricating oils, etc., increase enormously under hydrostatic pressures of the order of several thousand atmospheres, an extension of Poiseuille's law had been published earlier (*J. Wash. Acad. Sci.*, 1916, **6**, 525–530). This is discussed further, and illustrated by experimental data.

Starting from a given empirical relation between viscosity and pressure, an expression for the corresponding correction factor in the form of Poiseuille's law can be obtained by integration. Conversely, if the form of the function connecting viscosity with pressure is unknown, it can be determined by differentiation of the observed flow-pressure graph connecting rate of flow with inlet pressure. For the usual case it can be shown that the rate of

flow approaches an asymptotic limiting value. If for any reason the logarithmic viscosity-pressure diagram takes an upward bend, the viscosity increasing more rapidly than before, the rate of flow must actually decrease with further increase of inlet pressure, and the flow-pressure graph will pass through a maximum.

The foregoing analysis makes possible several different methods for computing the viscosity-pressure characteristics of a lubricating oil, or other liquid, from the simple experimental procedure of observing the efflux (by weighing the efflux obtained in measured time) out of a long metal capillary into the free atmosphere.

The paper includes a review of the calculations by S. Kiesskalt for flat capillaries (*Forschungarbeit. V.D.I.*, No. 291, 1927), and indicates under what conditions the extrusion type of high-pressure gauge proposed by C. Barus (*Am. J. Sci.*, 1893, **45**, 87) might be realised. The theory is illustrated by the experiments of C. Barus on marine glue to 30,000 lb./sq. in., and by more recent experiments by the authors on pressure-gun and cup-grease and on castor oil, to approximately 45,000 lb./sq. in. The capillary used had internal and external diameters of 0·0456 and 0·236 cm. respectively, and was 218·4 cm. long. The results obtained for castor oil by this method are in reasonable agreement with those computed from the data of Hersey and Shore (*Mech. Eng.*, 1928, **50**, 221), using the ball-and-slanted-tube viscometer, and by Kleinschmidt (*Trans. A.S.M.E.*, 1928, A.P.M.-50–4, 1–5), on the same sample of castor oil, using the falling-weight viscometer. On the whole, the long capillary method is less sensitive and less precise, but much more rapid than the other two methods. C. I. K.

132. Interfacial Tension Between Asphaltic Materials and Solutions of Alkaline Inorganic Salts. R. N. Traxler and C. U. Pittman. *Ind. Eng. Chem.*, 1932, **24**, 1391.—Interfacial tension has been determined between two asphaltic fluxes and various concentrations of five salts (Na_2HPO_4, $Na_2B_4O_7$, Na_2CO_3, Na_2SiO_3 and Na_3PO_4) which hydrolyse to give sodium hydroxide. It is shown by means of curves that the interfacial tension between the fluxes and the different alkaline solutions decreases toward zero as a limit with increasing concentration. Solutions of trisodium phosphate and sodium metasilicate give lower interfacial tension than those of disodium phosphate and sodium tetraborate, sodium carbonate solution being intermediate between these two groups. When reaction occurs at the interface, the nature of the products formed may have a great influence on the type and stability of the resulting emulsion. The effect of pH and nature of anion are discussed. W. H. T.

133. Studies in Filtration. I. Critical Analysis of Filtration Theory. B. F. Ruth, G. H. Montillon and R. E. Montonna. *Ind. Eng. Chem.*, 1933, **25**, 76.—Existing filtration equations may be divided into two groups: those generally termed the Lewis equations and the various forms of Sperry's equations. These equations are reviewed and their failure to express adequately experimental data is pointed out. The suggestion is made that the filtration equations may rest upon an invalid basis and the authors consider the concept of specific resistance to be a particular case of this. Only in the case of incompressible materials is it possible to derive an equation from theoretical grounds, *i.e.*, from Poiseuille's law. Experimentally, it is found that the data for all types of materials exhibit a similar behaviour in the later stages of a filtration. The necessity for a study of the early stages of the filtration cycle for a large variety of substances to establish experimentally the exact relation between resistance and the variables affecting it is shown. E. N. H.

134. Combustion Charts for Fuels of Unknown Chemical Composition. A. J. Kilgore. *Petr. Eng.* Nov., 1932, **4** (2), 88.—A method is described of computing a combustion chart suitable for practically all types of fuels (except producer gas and blast furnace gas), from the Orsat analyses of the flue gases, instead of from chemical analyses of the fuels. This is of particular value when variable mixtures of fuels—*e.g.*, coke gas and oil are burnt.

If desired, the chart can be completed so as to conclude the analyses of the flue gas obtainable from fuels burned under all possible conditions. Examples of the use of the chart are given and a specimen chart for petroleum coke with 7% volatile matter reproduced. C. L. G.

135. Photographic Methods for Measuring Velocities of Explosion Waves and Shock Waves. W. Payman and D. W. Woodhead. *Fuel*, 1932, **11**, 435.—Various photographic methods, which have been, and may be, utilised for the examination of explosion waves and shock waves, travelling in tubes or expanding freely are reviewed. The application of stationary and moving mirrors, together with forcible combinations of lenses, to the examination of such waves photographically is discussed. H. E. T.

136. Audiometer Limitations. D. P. Barnard. *Oil and Gas J.*, 3.11.32, **31** (24), 16.—Whilst ultimately the criterion of detonation must be the human ear, its well-known variable sensitivity and fatigue characteristics have led to the attempt to use audiometers in detonation research work. The type used in the Whiting Research Laboratories of the Standard Oil Co. (Indiana) is illustrated. The filter element passes all frequencies above 2000/2500 cycles per sec., in which range the bulk of the noise of detonation occurs, and quite effectively prevents from appearing in the output virtually all mechanical engine noises, except those due to valve tappets, which are overcome by suitable location of the microphone. The application of the instrument in bench and road tests for determining the octane rating of fuel necessary to eliminate detonation noises in the engines tested is illustrated and described. The audiometer, however, can only judge sounds on a frequency basis, and even then not too definitely, and is entirely incapable of distinguishing "pleasant" from "unpleasant" sounds of the same or different frequencies. For example, there is reason to believe that not all of the sounds registered in the tests mentioned above would be considered objectionable by the automobile occupant. It was for this reason that the C.F.R. Road Correlation Committee decided to employ human judgment in its work of correlating C.F.R. detonation procedure with road performance.

The audiometer can be a very useful tool, but the experience of the writer's laboratory is that for internal combustion work in particular it should be provided with a series of high, and preferably several, band pass filters, if it is to give values capable of reliable interpretation. R. A. E.

137. Catalytic Vapour-Phase Hydration of 2-Butene under High Pressures. L. F. Marek and R. K. Flege. *Ind. Eng. Chem.*, 1932, **24**, 1428.—It is shown that catalytic vapour-phase hydration of 2-butene at 427°—538° C. under continuous flow at pressures of 3000 and 5000 lb. per sq. in. results in the formation of 2-butanol, the yields however being low. With increasing mole ratios of steam to 2-butene, conversions to hydrated products or 2-butanol increase while conversion of 2-butene to polymer decrease, and the concentration of hydrated product decreases. An increase in pressure from 3000–5000 lb. per sq. in. has a more pronounced effect on polymerisation than on hydration reactions. Catalysts, *e.g.*, phosphoric acid and cuprous chloride supported on pumice, promote the hydration of 2-butene at temperatures between 400°–500° C. A diagram and description of the apparatus used is given together with the method of operation. W. H. T.

138. Decomposition of Mineral Oil by Heating under Pressure. S. Philippide. *Petr. Z.*, 21.12.32., **28** (51), 1–6.—The constituents boiling over 200° of an American illuminating oil were heated at 600° under a pressure of 0–20 atm. with an oil velocity of 45–270 gm./hr. The oil was passed in a uniform stream through a pressure tube heated electrically to 600°, and the quantity of gaseous and liquid products measured. One part of the decomposer was filled with clay and another part with a mixture of 90% of fuller's earth and 10% of powdered clay as catalysts. It was found that the type of decomposition depended entirely on the time that the oil was present in the decomposer and on the catalyst. The pressure had very little effect and retarded the velocity of the reaction. W. S. E. C.

139. Preparation of Paraffins from Carnuba Wax by Means of Catalytic Hydrogenation. H. I. Waterman, P. de Kok and A. J. Tulleners. *J. Inst. Petr. Techn.*, 1932, **18**, 1007–1009.—The results of two experiments on the hydrogenation of Carnuba wax at maximum temperatures of 437° C. and 393° C. in the presence of a catalyst are given. The product obtained was solid paraffin of m.p. 57°/59° C. G. R. N.

140. Equilibrium Dehydrogenation of Ethane, Propane and the Butanes. F. E. Frey and W. F. Huppke. *Ind. Eng. Chem.*, 1933, **25**, 54.—Using air-dried chromic oxide gel as catalyst, ethane, propane, n-butane and iso-butane are dehydrogenated at temperatures from 350° to 500° C. and 760 mm. pressure. Equilibrium dissociation is obtained and demonstrated by approach from both sides, with little interference from side reactions and equilibrium constants calculated from the relationship :—

$$K = \frac{(C_n H_{2n})(H_2)}{C_n H_{2n+2}}$$

with concentrations expressed in atmospheres. At 400° C. and 760 mm. pressure the dissociation of ethane, propane, n-butane and i-butane are 1·2, 4·5, 8·5 and 9·2% respectively.

N-butane forms all three of the n-butylenes and of the *cis* and *trans* forms of 2-butylene the lower boiling hydrocarbon is designated the *trans* isomer. The equilibrium dissociation is the same for the formation of 1-butylene as for propylene, but both 2-butylenes are produced in higher concentration. Evidence indicates that of the 2-butylenes the lower boiling (*trans*) isomer is more stable.

The free energies of dehydrogenation of ethane, propane, n-butane and i-butane are calculated and tabulated. E. N. H.

141. Testing of Cut Oil. W. Woelflin. *Petr. Eng.*, Oct., 1932, **4** (1), 76.—The variations in the A.S.T.M. method D.96 for water and sediment in petroleum products, as used by different companies, are described. The changes include : different type of diluent, variation in the speed of the centrifuge and the size of the centrifuge tubes. Wax is often precipitated with the B. S. and W. To remove this the sediment should be stirred up, using a pointed wooden stick and heated in a water bath at 110° F./130° F. for 10 mins. and recentrifuged. The use of a petroleum ether-benzole cutting solution permits easy solution of asphalt and wax, while its light gravity allows the small particles to be centrifuged out.

In order to show the actual amount of water, instead of emulsion, phenol or tret-o-lite or similar demulsifying chemicals are added to the tube. Variations in the proportion of diluent to oil occur in various laboratories. The 100 ml. pear-shaped or pointed centrifuge tubes are usually used, but the 15 ml. pointed tubes are used in some parts.

The centrifuging machines usually comply with A.S.T.M. requirements, but the speed is in some cases increased to 2000 r.p.m. where very fine emulsions are encountered. The cutting solutions include gasoline, pet. ether, benzole, CS_2, ether and mixtures with the addition of phenol, tret-o-lite, etc.
C. L. G.

142. Continuous Acid Treating of Oils in the Laboratory. E. V. Zublin. *Oil and Gas J.*, 17.11.32, **31** (26), 74; *Refiner*, 1932, **11**, 558–559.—A simple and effective laboratory apparatus for carrying out continuous treatment of gasolines and distillates is described. Laboratory refining tests are usually carried out on the batch system, whereas it is well known that continuous and batch treatments frequently yield very different results, both as regards quality of final product and magnitude of sludge losses, etc. The apparatus consists of a pyrex glass agitator fitted with an air-wheel-driven paddle which can be rotated safely at 2000 r.p.m. The agitator has a volume of 60 ml. and has dents in the side walls to ensure thorough agitation. The liquids to be mixed are fed by gravity to the agitator, a constant head being provided, to avoid the use of cocks, and the treated oil and sludge run into clay, through which the treated product trickles into a receiver.

Data are given for the treating loss and quality of a highly-cracked distillate treated by the laboratory batch process and by the continuous method outlined.
C. L. G.

143. Some Properties of Synthetic Lubricating Oils. D. P. Barnard. *Nat. Petr. News*, 16.11.32, **24** (46), 62.—The procedure adopted in the commercial synthesis of oils has consisted of polymerising certain olefins to viscous bodies in the presence of anhydrous aluminium chloride. The characteristics of the final product are determined primarily by the composition of the charging stock used in the preparation of the olefins.

Tables are given showing the effect of molecular weight and isomerism on the viscosity of the resultant products.

Details are given of three series of tests carried out on a synthetic lubricant, against three representative oils of conventional type.

Tests were conducted on dynamometer units, standard motor cars, and in aero engines.

The results tend to show that, while the consumption was higher in the case of the synthetic oil, the condition of the synthetic oil after the test was much superior to that of the conventional type oils. Sludging was almost negligible, and acidity and carbon deposit were much lower. After the test, an engine running on the synthetic oil could be washed clean with naphtha only.

The conclusion is drawn that the apparent superiority of the synthetic oil is due to the virtual absence of preformed or potential asphaltic-forming material.
H. G.

144. Deterioration of New and Used Transformer Oils. K. O. Müller and F. G. Consolati. *Erdöl u. Teer*, 1932, **8**, 525–527, 540–542, 557–559.—The authors give a description and discussion of the method proposed by Weiss and Salomon for the examination of transformer and turbine oils as regards their tendency to deterioration in use.

The apparatus consists of an oil-bath, electrically heated, and fitted with a stirrer and a perforated cover, into which are fixed a number of aluminium tubes. The oil-bath is filled with superheated steam cylinder oil and maintained at 120±1° C. In the aluminium tubes are placed the test vessels, of resistant glass and containing 65 ml. of the oil to be examined, and also a spiral of 32 cm. cleaned copper wire. The transformer oil is heated at

115 ± 1° C. in this apparatus until the first trace of sludge appears in the hot oil. This time, in hours, is noted, and further tests carried out, heating for 2, 3, 4 and 5 times this period. The time for the first appearance of insoluble sludge in the oil—the " period " of the oil—and the amount of sludge found in the oil at the end of this period are characteristic of the oil. The amount of sludge usually increases regularly with time of heating, the curve of sludge against time being parabolic at first, but possibly becoming linear after about five periods.

New transformer oils behave very differently under the test. They usually darken to a yellow-brown colour, but sometimes blacken. Organic acidity may develop to the extent of 1 to 3%, as a rule (but occasionally to 10%), with super-refined oils, and up to 0·4% with ordinary oils.

The time of the first precipitation of sludge is difficult to determine in the case of super-refined oils, owing to the comparatively great solubility of the sludge in the warm oil.

The behaviour of used oils on artificial ageing depends largely on whether they have already begun to deposit sludge in the transformer.

After the oils have been heated for the required periods, the sludge contents are estimated by precipitation with normal benzine, and the acid number is also determined, details of the methods employed being given. The sludge factor for the oil is determined from the relation—

$$D_n = d\left[1+\frac{n}{2}(n-1)\right]$$

where D_n is the sludge after the nth period and d the sludge after the first period. The sludge factor is the quantity $\left[1+\frac{n}{2}(n-1)\right]$.

Some oils give a double curve, owing to the sludge at first being very soluble in the hot oil and giving low values at first in consequence.

A modified method is also described, whereby results can be obtained in three days at the most. E. B. E.

145. Thermal Decomposition of Paraffin Wax in the Presence and Absence of High-Pressure Hydrogen. H. I. Waterman, A. J. Tulleners and J. Dooren. *Proc. K. Akad. Wetensch., Amsterdam*, 1932, **35**, (8).—In previous work a comparison was made between the gaseous and low-boiling products obtained by the decomposition of wax in the presence and absence of hydrogen. The present investigation concerns the products of these types of decomposition previously freed from lower-boiling gasoline. Each of the residues was distilled, first at atmospheric pressure to 240° C., then at 8–10 mm. pressure up to 210° C., and finally under cathodic vacuum at 100°–225° C. for the cracked product and 107°–178° C. for the hydrogenated product, all the distillates being subsequently analysed (*e.g.*, S.G., mol. wt., ref. index., br. number, aniline pt., etc). The last distillate from the cracked residue was hydrogenated at 225° C., using nickel on kieselguhr as catalyst, and the products compared with the other distillates. The results of this comparison enabled a measurement to be made of the quantitative formation of cyclic compounds during cracking. It is evident that the presence of hydrogen tends to inhibit the formation of ring compounds, the reduction being to about one-seventh of that experienced in cracking. W. H. T.

146. Colloid Chemistry of Asphalts. C. Mack. *J. Phys. Chem.*, 1932, **36**, 2901.—From a consideration of asphalts as a solution of asphaltenes in a mixture of asphaltic resins and oily constituents, viscosity measurements have indicated that asphalts have high relative viscosities at low temperatures only, whereas they behave like ideal solutions in the liquid state.

Among the asphalts investigated, structural viscosity relationships have not been found to occur, although it is probable that structural viscosity is more pronounced with higher concentrations of asphaltenes.

It has been found possible to calculate the molecular weight of the solute from viscosity measurements, by means of the equation :—

$$\text{relative viscosity} = e^{ckM}$$

where c denotes concentration in weight %, k is a constant, and M is the molecular weight.

By applying this equation, together with adsorption measurements of asphaltic resins in asphaltenes, it has been indicated that, contrary to general opinion, high relative viscosity is brought about by association rather than by solvation.

The equation of Weimarn dealing with particle size and degree of supersaturation was found to hold qualitatively for asphalts from two different sources, which have the same asphaltene content, but shows differences with respect to susceptibility to temperature change. H. E. T.

147. Bitumen Emulsions. G. Keppeler and K. Dohse. *Asphalt und Teer*, 1932, **32**, 657–659, 939–940.—I. *Determination of Water.*—Direct distillation and distillation with xylole are compared. The addition of sodium chloride and a high-boiling paraffin oil is advocated to make the distillation proceed more smoothly, and at the same time to render the residue more fluid. A table gives comparative results by : (1) direct distillation ; (2) with addition of sodium chloride ; (3) addition of paraffin oil ; (4) addition of both sodium chloride and paraffin oil. The latter is considered most satisfactory, using 10 g. emulsion, 5 g. sodium chloride and 20 ml. paraffin oil. The xylole method is then discussed, and the procedure recommended is to take 10 g. of emulsion and add 5 g. dried sodium chloride and 50 g. of xylole. Experiment showed that the results by this method are low by a constant amount, governed only be the particular apparatus used (size of flask, etc.), and it is considered that this constant should be determined for each apparatus, using xylole with a known amount of water present.

II. *Determination of Bitumen.*—Allowing the emulsion to dry out on a porous plate is unsatisfactory, owing to the time taken to attain constant weight, and also the bitumen may still include emulsifier and some water. The extraction method is more satisfactory. 10–20 g. of emulsion are taken, and twice as much anhydrous sodium sulphate added. The mixture is extracted in a Soxhlet with benzole, as usual. By exhausting the residue with water to remove the sodium sulphate, any water-insoluble material can be estimated. A separate determination of ash gives the total mineral matter, so that the water can be determined indirectly by difference. Tables show the relative amounts of bitumen found by the extraction method and by the porous plate, also the water found indirectly and by the xylole method.

In the case of tar-containing emulsions, a second extraction with trichlorethylene is necessary. Free carbon can, in this case, be estimated after extracting the residue with water. A typical analysis of such an emulsion is given. C. C.

148. Physical Properties of Mixtures of Bitumen and Finely Divided Mineral Matter. A. Evans. *J. Inst Petr. Techn.*, 1932, **18**, 957–991.—A comprehensive examination of asphaltic cements in relation to the properties of their constituents is described. G. R. N.

149. Particle-Size and Surface of Mineral Fillers. C. Ziegs and H. Nussel. *Bitumen*, 1932, **2**, 134–139, 156–158, 179–184.—The action and influence of fillers in mineral mixtures for asphalt road construction are first discussed.

Fillers raise the softening point, decrease the penetration, decrease the temperature-susceptibility and improve the tensile strength. For the construction of good asphalt surfaces, both the surface area of the mineral matter and the voids must be taken into account. As the amount of fillers increases, the surface also of the mineral matter is increased, while the voids reach a minimum.

The paper deals at length with the particle-size and surface area of various finely divided mineral fillers. Methods of separating the latter into definite fractions include: elutriation, sedimentation and sifting by air currents. Objections to the first two methods are indicated, while the apparatus of Gonell for separation by air currents is described and illustrated. The authors have separated fillers into five fractions, 0–10μ, 10–30, 30–50, 50–74 and over 74μ (74μ = mesh of A.S.T.M. sieve No. 200), the portion passing the 200 sieve being treated in the Gonell apparatus. The results for 36 fillers are given in tables, both the percentages of the various fractions being shown, and, in separate tables, the corresponding surface areas. The inadequacy of sieve analysis is clearly shown, *e.g.*, a quartz and a limestone filler—giving 7% and 23%, respectively, residue on 200 sieve—the latter showed much the larger proportion of finest particles, and the total surface was correspondingly greater. Therefore the only satisfactory way of comparing fillers is to examine the portion passing the 200 sieve.

It is shown that the figure normally taken for the surface of the fine particles passing 200 sieve (90 m.^{2}/Kg.) is much too low, and an error is therefore introduced into the calculation of the amount of bitumen to give a layer of certain thickness with a particular filler.

The authors deal at length with the work of Pöpel, and they consider that the results he obtained are unsatisfactory.

Finally, the importance of the degree of fineness and surface area on the effect of different fillers on bitumen is emphasized, and it is pointed out that it is essential that material of the same particle size and same surface area must be compared if satisfactory conclusions are to be drawn from the action of fillers from different stones. C. C.

150. Weight-Per-Cent. Equation. H. G. Nivitt. *Chem. Met. Eng.*, 1932, **39**, 673–675.—The weight-per-cent. equation gives the relation between the percentage composition of a binary mixture, according to one basis of measurement and according to another, where the second composition percentages are weighted with respect to the first. This equation can be readily solved by the use of two charts that have been constructed. Examples of their use are given, such as finding molal per cent. from weight per cent. (and reverse), volume per cent. from weight per cent., etc. G. R. N.

151. Gravity Flow of Liquids in Pipes. R. T. Businger. *Refiner*, 1932, **11**, 600–603.—The equations of Williams and Hagen, Chezy, and Kutter for water flow are cited, the adaptation of these to apply to all liquids is explained, and charts are provided to enable the value of functions in the various equations to be ascertained. B. C. A.

See also Abstracts Nos. 111, 114 and 159.

Class 600. Refining and Refineries.

152. Synthesis (and Development) in the Refining Industry. G. Reid. *Refiner*, 1932, **11**, 617–618.—The trend of the refining industry is traced, particularly with reference to motor fuels and lubricants and the cracking process. Developments in lubricating oil manufacture are noted, particularly

synthetic lubricants, and the further development of extraction processes typified by the phenol and nitrobenzene processes, together with the development of the Edeleanu process by the use of the dual solvent benzole and sulphur dioxide. In synthesis, other than for the production of petroleum products, the refining industry tends to encroach on the markets of the strictly chemical industries. B. C. A.

153. Heat Transmission from Metal Surfaces to Boiling Liquids. I. Effect of Physical Properties of Boiling Liquid on Liquid Film Coefficient. D. S. Cryder and E. R. Gilliland. *Ind. Eng. Chem.*, 1932, **24**, 1382.—Direct measurements of boiling-liquid film coefficients of heat transmission have been carried out by means of an experimental evaporator consisting of an electrically heated brass tube suspended in the boiling liquid. By means of suitable thermocouples, temperatures of both the pipe and liquid were measured at widely varying temperature differences for each of eleven different liquids. Equations have been developed to correlate the heat transmission coefficients so obtained with the physical properties of the boiling liquids. W. H. T.

154. Gauge for Measuring the Internal Wear in Cracking Still Tubes. Anon. *Nat. Petr. News*, 16.11.32, **24** (46), 49.—The device consists of spring-actuated rollers which are kept in contact with the interior walls of the tube, and which are connected through cams and a rod with a calibrated dial at the other end of the apparatus. In this way the internal diameter of a tube may be determined at any point throughout its length. H. G.

155. Cracking of Cottonseed Oil. G. Egloff and J. C. Morrell. *Ind. Eng. Chem.*, 1932, **24**, 1426.—Cottonseed oil has been cracked under a self-generated vapour pressure of 9·5 kg. per sq. cm., the temperature rising to 485° C. The yields were: pressure distillate 71·1%, water 5·3%, coke, gas and loss 23·6%, the distillate yielding 58·7% of motor fuel and 10·6% of gas oil, calculated on the cracking stock. An analysis of the pressure distillate showed that the glycerides were decomposed into hydrocarbons, free and combined acids of relatively low molecular weight, and water. Analyses are also given of the refined motor fuel, the pressure distillate bottoms, the coke and the cracked gas. The water produced during cracking showed a relatively high acidity of 3·6 N. and contained traces of aldehydes. W. H. T.

156. Role of Oxygen in Conversion of Hydrocarbons (Pt. IV.). I. N. Beall. *Refiner*, 1932, **11**, 606–610.—A general discussion on cracking and oxidation, heat transfer in the vapour phase, contacting and mixing for reaction, conversion, the choice of hydrocarbons for oxidation, and the vapour phase under pressure. B. C. A.

157. Sulphuric Acid in Treatment of Pressure Distillate. A. W. Trusty. *Refiner*, 1932, **11**, 604–605.—The advantages attaching to use of sulphuric acid are stated to be: (1) Good colour can be obtained with almost any type of cracked distillate; (2) the gum can be reduced to any practical specification; (3) the sulphur content can be reduced considerably; (4) the odour can be improved remarkably; (5) the stability to sunlight is markedly increased.

The disadvantages are: (1) A treating loss is incurred varying with the amount of acid used; (2) a loss in knock rating is incurred, depending on amount of acid used and nature of distillate treated; (3) acid formation is caused on rerunning acid treated distillate. This acid formation results in corrosion to distillation equipment and loss in colour.

The action of sulphuric acid on various types of hydrocarbons and sulphur compounds is explained, and results obtained in the treatment of pressure distillate are quoted. It is shown that for cracked distillate from Smackover crude that there is an optimum amount of acid for the best colour, and that up to the limiting proportion of acid used, viz., 40 lb./t.rl., there is a continuous decrease in potential gum. B. C. A.

158. Note on the Preparation of Pure Methane from Natural Gas. H. H. Storch and P. L. Golden. *J. A.C.S.*, 1932, **54**, 4662.—Pure methane containing less than 0·05% ethane and no higher hydrocarbons has been prepared from Pittsburgh natural gas, by passing the natural gas through a layer of active charcoal. About 20 lb. of activated charcoal were required to produce 100 cu. ft. of methane, containing less than 0·5% of ethane, 4% of nitrogen and 0·2% of oxygen. The methane was subsequently purified by condensation in a bath of liquid nitrogen, the non-condensable gases being pumped off, and the methane repeatedly melted and frozen, with intermittent pumping off of the non-condensable gases, which are thus released. H. E. T.

159. Removal of Sulphur Compounds from Petroleum Distillates. H. N. Holmes, A. L. Elder and N. Beeman. *J. Phys. Chem.*, 1932, **36**, 2981.—Metallic sulphides have been found to remove sulphur compounds from petroleum distillates, cupric sulphide, however, being superior to other metallic sulphides. Silica gels impregnated with cupric sulphide are far superior to metallic sulphides without the gel support. The efficiency of sulphide-coated gels varies considerably with the temperature of activation, and during activation of the cupric sulphide-silica gel, free sulphur is liberated with formation of cuprous sulphide, and this free sulphur must be removed by adequate heating. The gels described may all be regenerated and used repeatedly with good results, and, moreover, they all give refined products of good colour. Adsorption methods for the removal of sulphur compounds from petroleum distillates do not, like sulphuric acid, cause extensive loss of valuable anti-knock material.

An improved form of lamp for the estimation of sulphur in gasolines is described. H. E. T.

160. Comparison of Natural Gas Absorption Methods at 35 and 150 lb. Gauge Pressure. M. E. Garrison. *Petr. Eng.*, Oct., 1932, **4** (1), 26; Nov., 1932, **4** (2), 84.—The reduction in the quantity of gas produced in the fields since the development of curtailment methods has lessened the profitability of absorption plants, while the rate of decline of gas pressure is also lowered. The choice of proper absorption equipment under these conditions has therefore to be made more carefully. In the East Texas field, owing to the low allowable production and the relatively wide spacing of the wells, it appears that absorption plants are not profitable, so that many thousands of cubic feet of wet gas are often blown into the air and lost. The standardization of gas-pressure levels for handling the gas in all the absorption plants in any new field is recommended. 35 lb. and 150 lb. are taken as two convenient gauge pressures, and the efficiency of absorption at these two pressures of a typical low-pressure Kettleman Hills' crude worked out. From the absorption angle there are three ways of looking at the problem: (1) Calculation based upon ideal gas laws; (2) calculation based upon average plant conditions; (3) calculation based upon a 99% extraction of the gasoline content from the gas.

Based on the application of a combination of Raoult's and Dalton's laws tables are given enabling the computation of the amount of absorption oil

required, the amount of condensate, its composition and the composition of the wet gas remaining after cooling.

The heat of absorption under the two sets of conditions, 35 lb. and 150 lb. pressure, are worked out and it is shown that the ratio of the gallons of oil circulated is 3·3 times greater for the lower absorption pressure.

The steam requirements per gallon of oil circulated for the two conditions are calculated. The operating advantages of the 150 lb. absorption system are summarised as follows: (1) Greater flexibility of the gas-gathering system to meet changing field conditions. Three pressure levels are provided, 150 lb., 35 lb. and atmospheric or vacuum pressure. (2) The variation in absorption oil rate for a change in gasoline content of the wet incoming gas is less for the higher absorption pressure. The 150 lb. method can handle more efficiently changes in capacity and composition than the 35 lb. method. (3) The 150 lb. absorption method yields less fixed gas from the vent tanks. The quantity of vent gas is greater per gallon of oil circulated, but its total quantity is less, owing to the considerably smaller quantity of oil circulated. (4) The condensate produced from the cooling of the compressed gas lessens the load on the absorption plant and provides far more efficient extraction of the gasoline from the gas.

At one of the major absorption plants in the Santa Fe Springs oilfields, where 150 lb. and 35 lb. absorption methods have been in use, the conclusions reached above have been verified from actual plant operation during the last two years. C. L. G.

161. Carbon Black in 1931. G. R. Hopkins and H. Backus. *Min. Res. U.S.*, 1931, Pt. II., 33–44.—The total output in 1931 was 280,907,000 lb., a reduction of 26% as compared with 1930. Texas was responsible for 75% of the production. Tables are given to show the production in various States, production due to the various types of process, number of plants operating in various States and their capacities, names of operating companies and the type of process which they employ, domestic consumption for various purposes, exports, and average yields per 1000 cu. ft. of natural gas burned. The channel process is responsible for more than 90% of the total output. Retort, or thermatomic black, differs from channel black in physical and chemical properties, and is greyish in colour, so that its chief use is as a reinforcing agent in rubber goods. The yield by the retort process is, however, much higher, viz., about 10 lb./1000 cu. ft. of gas, as compared with the general average of 1·44 lb. for all processes.

Losses in handling carbon black increased to 0·6% of the output in 1931. The total distribution of the product was 258,426,000 lb., an increase of 3% over that in 1930. Of this quantity 63% was used in domestic consumption and 37% exported. Of the domestic consumption, 83% was consigned to rubber companies, 10% to ink companies, 4% to paint companies and 3% used for miscellaneous purposes. Reasons for variation in consumption of the various industries, as compared with 1930, are given, and consideration given to competition experienced with other types of black. The quantities exported to the principal consuming countries are quoted, and compared with those of previous years. R. A. E.

162. Manufacture of Lucid Compounds. C. H. Kopp. *Petr. Eng.*, Oct., 1932, **4** (1), 84.—Compounds consisting of an aluminium soap emulsified with a medium motor oil are known as lucid compounds on account of their appearance. They are characterised by their extreme stringiness, adhesiveness and limpidness. Stringiness and adhesiveness can be secured by the addition of aluminium oleate or of oil of 100 viscosity at 100° F. containing dissolved rubber. Limpidness is acquired by control of conditions of

manufacture, especially in regard to rate of cooling and amount of soap used. Cooling is accomplished by drawing off the grease into rectangular, shallow pans 8 in. deep, and maintaining the room temperature at 70/80° F. Formulæ given for rubber and aluminium oleate compounds are: (1) Al. stearate 5·8%, motor oil (750 viscosity) 89·8%, 5% rubber solution 4%, stearic acid 0·5%; (2) Al. stearate 5%, Al. oleate 3%, motor oil (750 viscosity) 92%. Suitable methods of manufacture are given.

The greases are easily decomposed by water vapour, and this limits their field of application. For example, they cannot be used in automobile differentials and transmissions or in free-wheeling units. R. A. E.

163. Nitrobenzene as Selective Solvent for Manufacture of Lub. Oils). S. W. Ferris and W. E. Houghton. *Oil and Gas J.*, 17.11.32, **31** (26), 65; *Refiner*, 1932, **11**, 560–567.—A considerable amount of research has been carried out on the use of selective solvents in the manufacture of lub. oils having a flat viscosity-temperature curve from crudes which are relatively plentiful and cheap. The solvent must be: (1) Non-reactive with the oil stock; (2) easily separable from the respective fractions; (3) capable of effecting a sharp separation between paraffinic and naphthenic constituents; (4) possess high solvent powers. The stock employed in the preliminary tests had the following properties: Visc. S.U. at 100° F.—612 secs. A.P.I. grav. 20·6, viscosity gravity constant (V.G.C.) 0·874, visc. Index 19. Data is given for five representative solvents which have been tested. By the batch process SO_2 is the most selective solvent, but is incapable of producing a raffinate more paraffinic than about 0·830 V.G.C., whereas other solvents are capable of doing so, and are required in smaller proportions per unit volume of raffinate of a given V.G.C. Extractions were made at appropriate temperature for each of the solvents employed. Nitrobenzene at 32° F. is seen to be the most effective, followed by phenol at 131° F. and SO_2 at 19° F. Nearly 200 materials were examined, exhaustive tests being made on 30 of the more promising ones. The terms "nitraffin" and "nitreno" are used for raffinate and extract of the nitrobenzene process. Comparisons made between efficiencies of the continuous counter-current, batch counter-current, multiple extraction and batch processes show the relative merit to be in the order quoted. The order of merit of the solvent is not appreciably affected by change of process. Temperatures of effective extraction for nitrobenzene will vary from 30° F. for naphthenic stock with a low miscibility temperature to about 120° F. for a highly paraffinic stock, so that in counter-current extraction temperatures may be allowed to rise between the "nitrene" and "nitraffin" ends. The process may be applied to any petroleum stock containing enough paraffinic material to produce a "nitraffin" layer, and having a boiling range sufficiently high to allow separation and recovery of solvent. Information is given on stocks to which the process has been applied, using three-stage counter-current treatment, with details of yields, usage of solvent and V.G.C. of finished oils. The high gravity of the solvent renders it suitable for use with residue of high viscosity and/or asphalt content. The "nitraffin" has a lower viscosity than the original charge, and increase in the nitrobenzene-oil ratio decreases yields appreciably and further reduces the viscosity of the "nitraffin." Colour reduction to the extent of 65–95% is readily obtained. Wax is relatively insoluble in the solvent, so dewaxing of "nitraffin" or preliminary dewaxing of the stock is necessary.

Little difficulty is experienced with contamination of the solvent if the light ends are removed from the stock. Carbon residue values of "nitraffin" are lower than those of the stocks utilised, especially with distillates. The

application of the process to the manufacture of insulating oil and refrigerator oil is considered. A description of the plant employed is given, and special reference made to the recovery of the solvent. The bulk of the recovery (99%) is effected at temperatures ranging from 220–300° F., and the remainder at a temperature not exceeding 350° F. Absolute pressures ranging from 10–50 mm. are maintained at various points in the recovery system. It has been ascertained by careful investigation that little destruction of nitrobenzene occurs at temperatures below 350° F. The total volume loss of solvent in the process has been found to be 0·084% of the charge. The solvent is toxic, but the dangers of poisoning are considered slight, and can be easily avoided by reducing losses to a minimum, and by the application of reasonable precautions. Consideration is given to the costs of manufacture and to the utilisation of the "nitrene" produced.

R. A. E.

164. T.I.C. Process in France. A. Eichelbrenner. *Gas J.*, 1932, **200**, 739–741.—Tar is the most important of the binders used for surfacing roads in France, the annual consumption being approximately 600,000 tons; this result has been achieved by the use of a treated tar complying with the E.P.C. specifications and which is known as road tar. The chief requirements of a tar capable of giving, by itself or in admixture with bitumen, a binder suitable for surfacing roads are: deep penetration into the upper layers of the road at the moment of application, and the property of hardening and maintaining its elasticity while adhering strongly to the road material.

Tars from horizontal retorts and from intermittent chambers give tars having the above properties by straight distillation to 200–230° C., but tars from continuous vertical retorts need special treatment, and for this purpose the T.I.C. lead bath plant is used. The tar is distilled in a layer 7/16ths–9/16ths inch thick over a bath of molten lead. A constant thickness of tar layer is thus ensured, and, owing to the intimate contact between the molten metal and the tar, heat interchange is perfect. The T.I.C. process gives maximum safety in operation, and the still is very easily cleaned.

The distillation of continuous vertical retort tars is carried out in two stages. Part of the tar is treated at 200° C., and is then blended with tar treated at 270° C. in the proportions necessary to give a product meeting the E.P.C. specification.

A table shows characteristics of the tars in comparison with the E.P.C. specification.

A. O.

165. "Refractory Screen" Oil-Gas Process. Anon. *Chem. Met. Eng.*, 1932, **39**, 663.—This process is carried out in a standard water-gas set in which the generator grates are removed and replaced by a refractory checker work on which a bed of small non-spalling high temperature-resistant refractory blocks—the fractory screen—was built up. The generator and carburettor are heated up by means of oil burners. Fuel oil is sprayed into the generator after the heating-up period, and is cracked on passing through the refractory screen to permanent gas and carbon. The gas is enriched in the carburettor, and finished in the superheater in the usual way. An important advantage of this process is the absence of ash and clinker. Some operating results are given.

G. R. N.

166. Influence of Bunker Enriching Oil on Composition of Distillates from Water-Gas Tar. C. W. Griffin. *Ind. Eng. Chem.*, 1933, **25**, 89.—The practice of using bunker oils for enriching water gas is of fairly recent application. The tar produced under these conditions in the particular case considered

was distilled with the idea of producing pitch melting at 68° to 75° C. The distillate oil amounted to 23% of the weight of the tar, and was divided in the plant operation as follows: (1) 70% of the distillate was collected as a fraction of specific gravity less than water, and (2) the remainder was collected as a fraction of specific gravity greater than water. The lighter oil, after removal of tar acids and bases, was fractionated three times, using a fourteen-ball column. Indications were obtained of the presence of toluene, the xylenes, mesitylene, pseudocumene, hemimellitene, naphthalene, methylnaphthalenes, dimethylnaphthalene, anthracene and phenanthrene and derivatives were prepared where possible.

The heavy oil was treated in a similar manner and contained methylnaphthalenes, dimethylnaphthalenes, anthracene, phenanthrene and methylanthracene.

Finally, an estimate was made of the quantity of the chief components in the total oil. E. N. H.

167. Standard Costs in the Oil Refining Industry (Part I.). G. C. Harrison. *Refiner*, 1932, **11**, 611–613.—Introducing the application of standard costs to refinery control. This system is claimed to save clerks and the time of the executive. Based on the principle of "exceptions" or variances from standard, this method permits of a clear appreciation of variations in cost and the causes thereof.

The type of information that standard costs were developed to give are illustrated by the following descriptive titles of statements which might be supplied for the use of a refinery superintendent:—

1. A focussed summarised statement showing how costs in total compare with standard analysing, the variation from standard by causes and distinguishing between variations within refinery control and outside it.

2. Detailed statement showing how the costs of each operating unit compare with standard and analysing variations from standard by causes so that immediate steps can be taken to convert conditions adversely affecting costs of production. B. C. A.

168. Ammonia as Agent in Combating Corrosion in Modern Non-pressure Refinery Equipment. S. S. Shaffer and J. E. Pollack. *Oil and Gas J.*, 17.11.32, **31** (26), 89; *Refiner*, 1932, **11**, 568–572.—The protection of condensers by the use of ammonia is discussed and a preliminary résumé given of plant experience of refinery corrosion in tanks, lines, stills and fractionating equipment and condensers.

Corrosion in condensers starts at the point of condensation, the water condensing and dissolving the accompanying acids HCl, H_2S and SO_2. The corrosion of coil type condensers is discussed in *Oil and Gas J.*, 31.3.32 (see Abstract 610/1932). Liquid ammonia is conveniently stored under pressure in discarded pressure drums from cracking equipment, a roof being provided to cut off the direct rays of the sun and provision being made for heating during the winter months. Distribution of ammonia is made by 1 in. steel lines reduced to ¼ in. at the condensers. Connection at the vapour line is made by an inverted U-tube to prevent condensate collecting and running into the water, and a small quantity of water is fed to the vapour line so that the normal amount may be augmented if necessary to ensure complete removal of ammonia salts. The intensity of corrosion will depend on the amount of water present in the crude and the salinity (calcium and magnesium) of the water. For crudes of low salinity little corrosion may be caused by the first two or three streams, but as the distillation temperature is raised and steam is used, the calcium and magnesium chlorides break down and more HCl is evolved. In some crudes, *e.g.*, North-east Texas

corrosion of this type is small, whereas in Salt Flat crude, which is deficient in light ends, and requires the use of steam in the first still, serious corrosion results in the first two condensers, the remainder being free from corrosion since the calcium and magnesium chlorides have almost completely broken down. Although corrosion is affected by H_2S there seems to be a definite relation between the chlorides present and the iron losses which is independent of at least moderate amounts of H_2S. The ammonia should be added in slight excess to the equivalent amount of chloride present. It is not necessary to neutralise to a pH7 value, 5 being sufficient, showing that the H_2S present in a closed condenser is harmless in the absence of air compared with HCl. The results of ammonia tests on North Texas, Salt Flat, Reagan and Panhandle crudes are tabulated with the optimum amount of ammonia and the reduction of iron losses effected. Approx. 3 lb. ammonia per 1000 lb. of crude is found to reduce iron losses by 80/90%. In closed type exchangers using Admiralty or Monel metal tubes ammonia was found unsuccessful in preventing deposition of copper sulphides, etc.
C. L. G.

169. Effect of Turbulent Flow on Condenser Efficiency. B. T. du Pont. *Nat. Petr. News*, 16.11.32, **24** (46), 74.—The fundamental principles of heat transference are discussed at some length. It is shown that the resistance offered to heat transference by the metal is negligible compared with that of the fluid films on either side of the metal wall. In order to reduce the effect of the fluid film experimental condensers having internal "Swirler" fins to produce turbulent flow have been tested. Data are given to show that the capacity/section is thereby increased by 18.4%, and the capacity/lb. is increased by 29%, while the weight/section is decreased by 8%. The tests were run against standards provided by tubes smooth within and without and tubes having external fins.
H. G.

170. Thermal Conductivity and the Plate Efficiency in a Rectifying Column. C. P. Warden. *J.S.C.I.*, 1932, **51**, 405T–411T.—This author has examined the plate efficiency of a rectifying column in relation to the thermal conductivity of the plate material. Ethyl alcohol and water mixtures were fractionated under conditions of total reflux using plates made of Vitreosil, cast iron and Alpax. The latter is an aluminium alloy containing 12% of silicon.

The results indicated that the degree of fractionation increased as the thermal conductivity of the plate material increased.
W. E. J. B.

171. Modern Construction Materials. Anon. *Chem. Met. Eng.*, 1932, **39**, 651–658.—A compilation of tables giving the physical and mechanical properties as well as the chemical resistance of a large number of construction materials. These include steels, silica, stoneware, glass, wood, cements, carbon, refractories, rubber, plastics and heat insulating compounds.
G. R. N.

172. Head Design for Pressure Vessels. I. C. O. Sandstrom. *Chem. Met. Eng.*, 1932, **39**, 668–672.—The first of a series of three articles on the head design of pressure vessels. It deals with the designing of heads for tanks and heat exchangers. Graphs of the plate thickness for blank and manhole heads for various pressures as well as some examples are given.
G. R. N.

173. Modern Construction of Pressure Vessels by Fusion Welding. F. Swindell. *Refiner*, 1932, **11**, 614–616.—Recent improvements in the art of welding have rendered possible the fabrication of vessels of almost any desired length and diameter and for all hazardous uses. Joint strength of the modern fusion

welded pressure vessel closely approaches that of the pierced steel ingot vessel. "Shielder Arc Welding" is quoted as one of the greatest single contributions to fabrication technique. Fundamentally this method involves the fusion of metal in a neutral or reducing atmosphere as opposed to the oxidising atmosphere associated with the open arc method.

A cracking tower with a wall thickness exceeding 3 in. is cited as a practical example, and the precautions associated with welding construction are illustrated by quotations from the A.S.M.E. code. B. C. A.

174. Replacing Sections of Riveted Bubble Tower Shell. W. Samans. *Refiner*, 1932, **11**, 573–575.—A description with drawings and photographs of a method used to replace the four lower rings each of two bubble towers, the upper rings and trays being left *in situ*. B. C. A.

175. Recovery of Refinery Contact Clays. E. W. Zublin. *Oil and Gas J.*, 27.10.32, **31** (23), 12.—Although little has been accomplished on the plant scale during the year, considerable laboratory work has been carried out and at least one pilot plant is in use.

The two successful lines of attack are: (1) washing and burning; (2) solvent extraction. In applying the first method it is essential to remove oil and naphtha as completely as possible before burning, in order to reduce losses, conserve oil and permit better temperature control during burning.

The temperature to which clays can be heated without loss of efficiency varies, but generally speaking temperatures of 900/1000° F. are possible. Some clays of the bentonite or sub-bentonite variety suffer loss in efficiency when heated by direct flame, and so cannot be successfully treated by burning. The removal of oil which precedes burning is generally effected by heavy naphtha applied hot on the filter, and the efficiency of the process depends on time and temperature of extraction and design of press. The individual influences of time and temperature are illustrated. The arrangement of the wash oil lines in certain types of press causes some parts of the cake to be washed more thoroughly than others. After washing, the cake is steamed to remove naphtha. When metal screens are used on the filter leaves it is sometimes necessary to use superheated steam to prevent clogging. Alternatively, agitation of the pre-washed clay with naphtha, refiltering and then steaming may be effective. With proper steaming the naphtha content can be reduced to less than 1%. Corrosion is a minor factor, monel metal screens having withstood 1000 steamings without deterioration. It is essential to use a closed press to protect workers from dust.

In the solvent extraction process, methods have been devised to reduce the losses of expensive solvent which have handicapped development of the method, and a pilot plant has been successfully operated in S. Texas. The process involves repeated leaching with consecutively fresher solvents, redistillation of solvent, vacuum drying of clay and recirculation of solvent. The method of operation is described and illustrated. No portion of the equipment is open to the air except the extractor at the time of charging with spent clay, during which period there is no solvent in the vessel. The type of solvent to be used for best results varies. Some mixtures that revivify clays used on naphthenic oils with efficiencies of 90/95% of the original, produce efficiencies of only 60% on clays used for Mid-Continent oils and *vice versa*. R. A. E.

176. Patents on Cracking. Verein. Stahlw. A.-G. E.P. 384,016, 1.12.32. Appl., 29.9.31. Conv. (Germany), 23.10.30.—A method of cracking is described which is characterised by the use of steel alloys not containing nickel but containing chromium in amounts preferably between 5 and 8% and small amounts of aluminium (1%) and copper (0·2–2·5%).

S. Swartz. U.S.P. 1,885,387, 1.11.32. Tube cracker giving longer continuous operation, diminished coke formation and increased yield of motor fuel. Means are provided for reversing the direction of flow in the cracking coil.

A. E. Harnsberger. U.S.P. 1,885,716, 1.11.32. Tube heater for vapour-phase cracking.

C. J. Greenstreet. U.S.P. 1,886,093, 1.11.32. Control of cracking conditions by cooling of the cracked products with hydrocarbon oil containing light fractions.

W. L. Bagwill. U.S.P. 1,886,621, 8.11.32. Cracking still with means for withdrawing asphaltic residual oil.

C. P. Dubbs. U.S.P. 1,886,946, 8.11.32. A heating coil in series with a number of enlarged coke-deposition chambers, any one of which may be bypassed.

R. T. Pollock. U.S.P. 1,887,039, 8.11.32. Cracking still with means for admixture of reflux condensate with charging stock.

C. L. Smith and C. P. Watson. U.S.P. 1,887,047, 8.11.32. Vapour-phase cracking in contact with finely divided solid catalyst. Cracking is controlled by mixture of the cracked vapours with cooling oil.

G. Egloff. U.S.P. 1,887,083, 8.11.32. Cracking of various types of charging stock under different conditions with subsequent blending of the cracked vapours.

E. C. Herthel and H. L. Pelzer. U.S.P. 1,887,128, 8.11.32. Vapour-phase cracking in combination with vapour-phase refining of the resultant motor fuel by means of adsorptive catalysts.

A. E. Harnsberger. U.S.P. 1,887,155, 8.11.32. A cracking coil fitted with a core, the latter having a rod wrapped helically around its outer surface. The rod imports a swirling movement to the oil vapour and aids uniform heating.

C. P. Dubbs. U.S.P. 1,888,028, 15.11.32. Cracking by direct contact with combustion gases.

G. Egloff and H. P. Benner. U.S.P. 1,888,029, 15.11.32. Cracking still in combination with a combined cracking and scrubbing vessel.

J. D. Seguy. U.S.P. 1,888,051, 15.11.32. Cracking coil connected to a reaction chamber and dephlegmator. The reflux is settled, vaporised by heat exchange, and returned to the cracking coil.

A. E. Harnsberger and C. L. Smith. U.S.P. 1,889,199, 29.11.32. Heating coil and furnace for vapour-phase cracking.

C. P. Dubbs. U.S.P. 1,890,316, 6.12.32. Continuous liquid-phase process with recycling of reflux and continuous withdrawal of heavy residue and carbon.

C. P. Dubbs. U.S.P. 1,890,974, 13.12.32. A cracking process in which a portion of the pressure distillate is returned together with charging stock to the dephlegmator.

C. P. Dubbs. U.S.P. 1,891,199, 13.12.32. A reduction of pressure on the liquid passing from a reaction zone is used for maintaining the oil at the bottom of the dephlegmator in a turbulent condition.

D. Pyzel. U.S.P. 1,891,218, 13.12.32. Cracked oil from a reactor is passed to a zone of reduced pressure in which vaporisation is checked by the introduction of regulated quantities of a cooling medium.

M. L. Chappell. U.S.P. 1,891,619, 20.12.32. Production of motor fuel and refined viscous oil by chlorination followed by treatment with metallic halide.

R. Cross. U.S.P. 1,892,038, 27.12.32. Liquid phase cracking with injection of gaseous material into the reaction chamber, with means for reducing pressure between the cooling and evaporation stages.

W. R. Howard. U.S.P. 1,892,434, 27.12.32. Liquid phase cracking with recovery of light fractions from the reflux condensate.

J. C. Morrell and J. G. Alther. U.S.P. 1,892,437, 27.12.32. Pressure distillate is mixed with steam and passed through a fractionating tower for the production of "end point" gasoline.

C. P. Dubbs. U.S.P. 1,892,451, 27.12.32. Oil is charged to two separate portions of the heating zone and the heat evolved during dephlegmation is used to volatilise an extraneous oil.

C. P. Dubbs. U.S.P. 1,892,452, 27.12.32. Cracking stock is pre-heated, first indirectly and then directly by the vapours present in the dephlegmator.

E. W. Rembert. U.S.P. 1,892,534, 27.12.32. Cracking by contact with hot non-oxidising gas, the gas mixture after cracking being cooled by contact with finely divided cooling liquid. W. H. T.

177. Distillation of Coal at a Low Temperature. C. Francois. E.P. 384,171–2, 1.12.32, Appl., 23.4.32.—The coal for distillation is divided into separate charges distributed in a series of small compartments arranged side by side to form a pocketed plate. Provision is made for heat to have access between the compartments, and swelling of the coal during distillation is prevented by superimposing the plates. The process may be continuous or discontinuous. W. H. T.

178. Patents on Hydrogenation. J. Mercier. U.S.P. 1,888,998, 29.11.32.—Synthesis of light hydrocarbons from a mixture of heavy hydrocarbons, carbon monoxide and hydrogen at 500° C. in the presence of catalysts. The mixture is then suddenly expanded and cooled to 180°–300° C. and again hydrogenated in the presence of catalysts.

C. Krauch and M. Pier. U.S.P. 1,890,434–9, 6.12.32. Destructive hydrogenation of liquid or solid carbonaceous materials, using a catalyst immune to sulphur poisoning.

C. F. R. Harrison. U.S.P. 1,890,852, 13.12.32. Liquid and vapour-phase hydrogenation reaction products are withdrawn to a separation zone from which low-boiling hydrocarbons are separated. W. H. T.

179. Patents on Motor Fuels. E. B. Miller. U.S.P. 1,886,260, 1.11.32.—Treatment of distillates with solid adsorbent (silica gel) impregnated with 3% of acid and capable of adsorption of water vapour (21% at 30° C. and 22 mm. Hg.).

E. B. Miller and G. C. Connolly. U.S.P. 1,886,261, 1.11.32. Treatment of distillates containing gum with 0·1–0·5% of 80–100% H_2SO_4, followed by contact with 4% of adsorbent at 150°–500° F.

F. W. Wagner and F. L. McIntire. U.S.P. 1,886,612, 8.11.32. Treatment of coal oil distillates with 0·4% of 66° Bé H_2SO_4, followed by neutralising with 0·4% of NaOH sol. (140 gms./litre) and distillation under partial vacuum below the decomposition temperature of gum-forming constituents and sulphur compounds.

A. E. Harnsberger. U.S.P. 1,887,018, 8.11.32. Vapour-phase refining of vapour-phase cracked spirit by contact under reduced pressure with a polymerising adsorbent.

N. H. Moore. U.S.P. 1,887,941, 15.11.32. Pressure distillate is chemically treated, vaporised under reduced pressure, again treated, and finally contacted with solid adsorbent in the vapour phase.

F. W. Heath. U.S.P. 1,888,382, 22.11.32. Cracked motor fuel is refined by treatment with a solution of an alkali-metal ferricyanide. The polymerised products are extracted with acid, and the treated material is neutralised and redistilled.

M. Smith. U.S.P. 1,889,388, 29.11.32. Vapour-phase treatment of light distillates with hydrogen in contact with a chromite of a metal (Cu or Cd) for the reduction of sulphur content.

J. C. Morrell and J. L. Essex. U.S.P. 1,890,229, 6.12.32. Cracked distillates are treated with borax at elevated temperatures below that of cracking in order to remove gummy compounds and oily polymers.

J. C. Morrell and J. L. Essex. U.S.P. 1,890,230, 6.12.32. Refining cracked distillates by distillation over a mixture of borax and adsorbent clay in the presence of steam.

A. Lachman. U.S.P. 1,890,516, 13.12.32. Sweetening motor spirit by treatment with an aqueous solution of an alkali salt (pH value greater than 7·4) containing activated charcoal.

P. Magill. U.S.P. 1,890,881, 13.12.32. Vapour-phase refining of cracked distillates by means of finely divided alkali metal intimately dispersed in a semi-solid mass of by-products produced by the reaction.

R. C. Osterstrom. U.S.P. 1,891,106–9, 13.12.32. Vapour and liquid-phase refining of cracked distillates by means of fuller's earth.

W. H. T.

180. Patents in Lubricating Oil. Atlantic Refining Co. E.P. 383,801, 24.11.32. Appl., 22.1.32. Conv. (U.S.A.), 23.1.31.—This is a process of refining viscous mineral oil to produce a lubricating oil of sp. gr. less than 0·910 and viscosity greater than 150 secs. (Say.) at 210° F. from a crude oil which on normal distillation yields a residue of viscosity 150 secs. (Say.) at 210° F. and sp. gr. greater than 0.928. The residue is mixed with benzonitrile and the mixture heated to effect solution. The solution is cooled and forms two layers, an upper one rich in paraffinic hydrocarbons and a lower one rich in naphthenes. The upper layer may be subjected to a further treatment with benzonitrile.

A. Lazar. U.S.P. 1,885,524, 1.11.32. Lubricating oil fractions are treated with liquid SO_2, the undissolved portion separated and distilled in the presence of an adsorbent decolorising material.

H. Nielsen and B. Laing. U.S.P. 1,886,262, 1.11.32. Production of lubricating oils (sp. gr. 0·95–1·08 at 12°–18° C. and static co-efficient of friction 0·1–0·85) from tar oils.

H. Lowery. U.S.P. 1,886,344, 1.11.32. Removal of slop-wax from oil by dilution with low-boiling hydrocarbon and the addition of small quantities of petrolatum. The mixture is chilled and the wax separated.

H. T. Darlington. U.S.P. 1,888,346, 22.11.32. Apparatus for the thin-film evaporation of lubricating oil stocks under vacuum. Solid adsorptive agent is dispersed in the oil before evaporation.

E. R. Lederer. U.S.P. Re 18,676, 29.11.32. A fully dewaxed lubricating oil is produced by treatment of a still residue with acid below 125° F., and then with decolorising clay. The oil is diluted with solvent, centrifuged at −20° to −40° F., and finally the diluent is removed.

M. Luther and M. M. Cunradi. U.S.P. 1,889,926, 6.12.32. Recovery of lubricating oils from hydrocarbon residues resulting from destructive hydrogenation. The residues are heated under vacuum and treated with saturated steam carrying a mist of water.

E. Pongratz and H. Zorn. U.S.P. 1,889,932, 6.12.32. Recovery of oil from residues obtained by a previous treatment of hydrocarbons with a metallic halide. The residue is distilled dry in contact with a material having a basic action.

C. R. Rodman and R. P. Dunmire. U.S.P. 1,890,265, 6.12.32. An electrical control system for refining transformer oil.

R. E. Manley. U.S.P. 1,892,283, 27.12.32. Dewaxing lubricating oil, using a filter aid.

R. K. Stratford. U.S.P. 1,892,655, 27.12.32. Refining lubricating oil by means of a selective solvent consisting of 65–95% of phenol and 35–5% of a polyhydric alcohol. W. H. T.

181. Patents on Asphalts and Fluxes.—K. D. Svensson. E.P. 384,138, 1.12.32. Appl. 18.2.32.—The material is a viscous composition obtained by mixing together an asphalt emulsion (min. 40%) and an unvulcanised or vulcanised colloidal solution of caoutchouc, gutta percha or balata (min. 40%). W. H. T.

T. H. Dowlen. U.S.P. 1,886,380, 8.11.32.—Manufacture of oxidised asphaltic products by the air blowing of asphaltic oils in stages at a uniform elevated temperature.

A. Loebel. U.S.P. 1,889,365, 29.11.32. SO_2 extract from heavy oil is mixed with asphaltic residues and the mixture air blown at elevated temperatures to form an oxidised asphalt.

H. B. Pullar. U.S.P. 1,889,697, 29.11.32. A continuous process for the oxidation of asphaltic residues. The latter are heated, atomised and then contacted with finely divided streams of air.

P. C. Keith. U.S.P. 1,891,890, 20.12.32. Production of commercial asphalt from cracking-coil tar. The tar is discharged from the cracking plant and while still hot is subjected to a vacuum to the extent necessary to produce a residuum of commercial asphalt. W. H. T.

182. Patents on Fuel Oil. E. Morrill. U.S.P. 1,886,293, 1.11.32.—Breaking emulsions in fuel oil. To the latter is added a mixture of a polynuclear aromatic hydrocarbon, an alkali and an oil-soluble water-repellant substance. W. H. T.

183. Alcoholic Solutions for Engine Cooling Systems. Carbide and Carbon Chemicals Corporation. E.P. 384,089, 1.12.32. Appl. 9.12.31. Conv. (U.S.A.), 6.1.31.—The solution consists of a mixture of ethylene glycol or glycerol and water together with 0·5 to 3% of a mixture of lard oil and mineral oil and 0·75% of triethanolamine, the latter acting as emulsifying agent. W. H. T.

184. Patents on Refinery Plant. W. G. Williams. U.S.P. 1,886,142, 1.11.32.—Fractional distillation by means of a succession of rotating retorts each heated by a liquid bath. Vaporisation is from thin films.

L. C. Huff. U.S.P. 1,886,957, 8.11.32. A fractionating tower, the conduits connecting the trays being constructed to impart a swirling motion to the vapours.

J. B. Rather. U.S.P. 1,890,886, 13.12.32. An improved means for separately supporting a fire box and still is described, by means of which the still can expand and contract independently of the fire box and setting. W. H. T.

See also Abstract No. 115.

Class 700. Utilisation.

185. Petroleum Coke as Refinery Boiler Fuel. O. F. Campbell. *Oil and Gas J.* 17.11.32, **31** (26) 85; *Refiner*, 1932, **11**, 576-581.—At a Houston (Texas) Refinery, boilers have been installed equipped for use with petroleum coke, refinery gas, and unsaleable fuel oil. The petroleum coke, which contains up to 14% water, is crushed to half size and fed to ball-type pulverisers, where it is ground to a fineness of 84/88% passing 200 mesh with less than 0·5% on 50 mesh. Owing to the water and oil in the coke the coke bunkers are designed with four sides of bunker outlets sloping 60° to allow of easy delivery. The pulverisers have a capacity rated on coal of 10,000 lb. per hr.

All four walls of the boiler furnace are cooled by means of refractory covered block waterwalls which cool the blocks and prevent the caustic soda in the coke ash from fluxing the refractory.

The furnace bottoms are covered with plastic chrome ore to prevent slag penetration. The molten ash floats on top of the slag and is drawn off every two weeks into an ash pit. A description is given of the layout of the boilers, etc., and a sketch of the burners are given. The fuel oil burners are inserted through small 2 in. pipes in the centre of the burners, which are of the steam atomising type, owing to the appreciable amount of suspended solids in the fuel. The pulverised coke and the primary air supply are delivered to the furnace through the large centre pipe and are deflected by means of a distributor into the secondary air stream. The gas burner consists of six separate alloy sections forming a gas ring, which is placed just behind the burner tile that surrounds a set of adjustable secondary air vanes. It was found possible to burn satisfactorily petroleum coke with a volatile content of less than 5% without the use of gas or fuel oil to maintain ignition. The position of the secondary air vanes is changed with the change in rating of the boiler, the lower the rating, the nearer the vanes are to being closed. No difficulties have been experienced in over eighteen months operation.

C. L. G.

186. Reduction of Vapour-Locking Tendency. H. S. White and F. B. Gray. *Oil and Gas J.*, 17.11.32, **31** (26), 62.—Laboratory tests and road surveys of fuel line temperatures have been carried out by the U.S. Bureau of Standards, but no vapour-lock tests on the road have previously been made. Such tests have now been conducted under the auspices of the C. F. R. Committee and the Natural Gasoline Association of America employing 50 cars, representative of 90% of those sold since 1926. A fuel of low vapour pressure (5·6 lb. Reid) was blended with increasing amounts of butane to increase the V.P. until vapour lock occurred. With each car three different sets of operating conditions were investigated: (1) Steady driving at 40 m.p.h. (approx.); (2) Idling after steady driving; (3) Accelerating after idling. Temperature measurements were made at various points in the fuel feed system to determine vapour-lock temperatures. Special precautions were taken in preparing samples of high V.P. and in sampling fuel tanks in order to ascertain the V.P. of the gasoline when vapour lock occurred, which is the test used as a basis of comparison. The points from which samples were drawn and those at which maximum temperatures were measured are stated. Observed temperatures are compared for all three conditions and each type of system with predicted temperatures of vapour lock deduced from the formula $t = 259 - 140 \log pr$ where t = temperature in °F., pr the vapour pressure (Reid). The formula was derived from laboratory tests using fuel systems

without excess capacity for delivering fuel, so it is to be expected that all observed temperatures are equal to or higher than the predicted ones, since in automobile practice all fuel systems are capable of delivering more fuel to the carburettor than is needed. The difference will depend on the surplus delivery capacity of the system, and it is estimated that 20° F. could be added to predicted temperatures if all fuel systems were capable of delivering 40 gals. per hr. For this reason fuel pump systems have an advantage over vacuum tank and gravity systems. This is offset to a great extent, however, by the additional weathering which occurs in vacuum tank systems as far as V.P. of the main tank fuel is concerned. Other graphs show the V.P. (Reid) of fuels which vapour-locked cars (*a*) at constant speed; (*b*) under the worst operating conditions for the particular car, plotted against atmospheric temperature. It is also shown that the temperature rise above atmospheric at significant points in the fuel systems is slightly smaller for the average 1932 car than for earlier models, and that when vapour lock occurs the fuel system is cooled by about 8° F. Information on the observed effects of vapour lock, the probable immediate cause and the relative ease with which the engine is restarted when actual stoppage has occurred, is given for each type of fuel feed system. R. A. E.

187. Design of High Speed Diesel Engines. C. C. Keane. *Petr. Eng.*, Nov., 1932, **4** (2), 92.—The performance of a Diesel engine depends on the efficiency of its fuel injection and fuel control systems, and the completeness with which combustion of the fuel is obtained. Two general systems of solid injection are used: (1) The common rail, in which the fuel is stored under pressure in a small manifold and injected into the combustion space through mechanically operated spray valves; (2) the individual pump, which employs pumps that deliver fuel to each cylinder and automatic spray valves.

The latter method is to be preferred because it is more flexible under variable loads. Indicator diagrams show that when using the common rail system and running at light loads, there is a distinct lagging period after the compression peak is reached, pressure dropping as much as 40/50 lb. before the combustion pressure begins to rise. Individual pump systems may be divided into two types, viz.: direct injection and precompression. The latter possesses two advantages: (1) The temperature of the walls of the pre-combustion chamber remains practically constant under all loads, resulting in perfect combustion and absence of noxious exhaust gas; (2) improvement in fuel distribution due to increased trajectory of the fuel drops.

Comparative dimensions, speeds and fuel consumptions of four well-known high-speed Diesel engines are tabulated. R. A. E.

188. New Diesel Truck Engine. S. A. Guiberson. *Oil and Gas J.*, 17.11.32, **31** (26), 42.—A description is given of a new 6-cyl. 240-h.p. Diesel engine which has been converted from a White gasoline motor and installed in a truck carrying a 35,000 lb. load. Power runs showed that the engine had great flexibility with high acceleration and a very high torque at low speeds. Tests were carried out on a variety of furnace oils, heating oils, gas oil and Diesel fuels, slight variation of the timing being required in the case of the volatile heating oil to avoid smoking or loss of power. In an actual road trial the truck transported a load of 34,000 lb. 1,286 miles in 45 hr. 56 min. at a fuel cost of $5·14. A maximum speed of 35 miles an hour was attained, with an average of 28 m.p.h. the truck doing 5 miles/gal. of fuel.

Details of the engine and its conversion from the original gasoline engine are given. C. L. G.

189. Piston Temperatures in a Solid-Injection Oil Engine. G. F. Mucklow. *Engineering*, December, 1932, **134**, 745–747.—The author deals with a series of experiments to measure piston temperatures on a single-cylinder 66 B.H.P. Crossby solid-injection heavy-oil engine under a variety of running conditions.

Thermo-couples were fitted in the piston crown, the junction of the crown and walls, below the first set of piston rings, and in the piston skirt. Four series of trials were run. In the first, temperatures were recorded with the engine running at steady loads varying from no load to full power; fuel consumptions, exhaust temperatures and losses to the cooling water were also recorded. In the second series, the piston temperatures were recorded at a large number of equal time intervals over a period immediately following a sudden change of load, and "warming-up" curves plotted. During the third series, the effect of variations in the cylinder-jacket water temperature on piston temperatures and consumption were noted. The fourth series was to observe the effect of free circulation of air to the underside of the piston crown; the conditions were as in the first series except that the plate sealing the space under the piston crown from the atmosphere was removed.

A detailed description of the method of, and engine conditions during, the tests are given, and tables and curves obtained from the observations are reproduced.

With variation of load, the temperatures at the piston crown and at the junction of the crown and walls varied considerably, whilst those in the skirt remained almost constant.

After a sudden change of load, the temperatures in the piston skirt became steady in about 20 min., whilst that in the centre of the crown was still rising after 50 min.

With increase in water-jacket temperature, the temperatures in the piston crown fell, those at the edge of the crown remained unchanged, and those in the skirt increased. The specific fuel consumption and the exhaust temperature were decreased owing to decreased piston friction and hence greater mechanical efficiency.

The removal of the diaphragm under the piston crown resulted in a slight fall in the temperature of the piston, the cooling effect being greatest in the piston crown and increasing with increase of load. The specific fuel consumption was not appreciably altered as the piston skirt temperature was not altered and the difference in crown temperature was not large enough to affect the process of combustion. J. M. F.

190. Metallurgical Problems arising from I. C. Engine Valves. J. R. Handford. *Engineering*, 1933, **135**, 55–58, 83–85.—The problem of obtaining a steel suitable for exhaust valves of modern I.C. engines has led to the intensive study of heat-resisting steels, especially of the special austentic steels; thus a general knowledge of the effects of the various elements in complicated alloys has been obtained. The author indicates the effect of the more important elements found in valve steels. Every single requirement for valve steels can be met, but as yet not all in one type of steel; the advantages of the various types of steels are dealt with. The more difficult of all requirements is that valve steels shall retain their original physical properties after an indefinite number of heatings to and coolings from their operating temperatures, and also retain these properties after long use at the working temperatures. The author describes and gives the results of tests on seven well-known steels to investigate this requirement. All the steels underwent some definite change by 1,000 hrs. treatment at the running temperatures of aero engines.

The cracking of the seats of valves is discussed, and experiments to investigate this described. By covering the faces of the valve seats with stellite, the usual wear and distortion and also the formation of fine cracks on the seats were lessened. The difficulties of effecting this covering, and tests connected with the covering, are described. J. M. F.

191. C. I. Engine and its Applicability to British Railway Traction. L. F. R. Fell. *Engineering*, 1933, **135**, 85–88.—In the author's opinion electrical transmission for applying the power of the somewhat inflexible C.I. engine to railway traction is by far the best means yet tested. The more important advantages of the oil-electric over the steam locomotive are detailed, and the services to which the former are applicable are investigated. They could be used advantageously for mineral trains, for medium and light passenger and goods trains and for shunting work. The conclusion is arrived at after considering initial costs, fuel costs, depreciation, length of uninterrupted working, and the labour costs for operators, cleaners, etc. To keep the initial cost as low as possible, a specialised high-speed type of engine is required. Three systems used successfully in the design of high-speed C.I. engines are described; the author prefers a single-sleeve valve engine as employed by Ricardo, as the engine parts would be less foreign to the workers in the existing locomotive shops. Auxiliary machinery should be such that as much as possible of the work done by the expensive generating set is transmitted to the driving wheels. Engine cooling should be on the evaporative principle, and carriage heating could be effected by exhaust-gas-heated boilers. J. M. F.

192. Coke Oven Tar. H. Broche, K. Ehrmann and W. Scheer. *Gas J.*, 1932, **200**, 490 (from *Gluckauf*, 1932, **68**, 965–982).—This describes investigations carried out in Germany by the Mathias Stinnes Colliery research section with the object of developing new uses for coke oven tar. Partial hydrogenation of the tar led to the production of viscous oils which were, however, unsuitable for the manufacture of lubricants.

Production of Motor Fuels by Processes involving Oxidation.—The oxidation of tar oils to carboxylic acids and their subsequent de-carboxylation to benzene were investigated. Vanadium pentoxide at about 440° C. was suitable as catalyst in the oxidation, whilst the second process was best effected by autoclaving a solution of the resulting acids in the presence of traces of NaOH at 420° C. For example, 100 parts of naphthalene gave 49 parts of benzene and 55 parts of pure CO_2.

Tar oils boiling between 200° C. and 260° C. are most amenable to this treatment, and about 24% yields of benzene and homologues result, together with 10% of fatty acids (mainly acetic) and carbon dioxide.

Use of Tar Oils in Diesel Engines.—The high ignition temperatures of tar oils are disadvantageous, but catalysts will reduce this defect—*e.g.*, oxides of cerium, thorium and vanadium supported on asbestos wool, or platinised or palladinised asbestos. The two latter will reduce the ignition point of tar oils from, *e.g.*, 440–470° C. to 160–180° C. The catalyst is contained in an insulated, corrosion-resisting chamber at the inlet to the oil jet of the engine, and good atomisation must be provided. W. E. J. B.

193. Benzole in Motor Fuels. Anon. *Chem. Trade J.*, 11.11.32, **91**, 456.—In a paper read to a meeting of Automobil und Flugtechnisch Gesellschaft in Berlin on September 8th, Dr. Enoch stated the production of benzole for the years 1929-31 in four of the principal countries. The consumption in Germany in 1931 of blends of benzole-benzine and benzole-alcohol-benzine was

450,000 tons out of a total liquid motor fuel consumption of 1½ million tons. By reason of its lower freezing point and higher hydrogen content, coke oven benzole is superior to pure benzole as a motor fuel. The properties of one of the principal benzole-benzine blends marketed are quoted. The ternary mixtures first contained 10% by volume of alcohol, but the proportion is now usually 15%, thus increasing the percentage of water necessary to produce turbidity from 0·6% to 1·0%. The addition of alcohol lowers the freezing point of the mixture and increases the anti-knock value, the octane number of the present mixture employed in Germany being up to 92.

R. A. E.

194. Economic Aspects of Utilization of Heavy Oil Fractions. S. B. Eckert and A. E. Pew. *Oil and Gas J.*, 24.11.32, **31** (27), 27.—Statistics quoted show that in 1921 there were 12,500 domestic burner installations in use, consuming 600,000 brls. of furnace oil, whereas in 1932 the number of installations is estimated to have increased to 774,500 and the consumption of furnace oil to 36½ mil. brls. The consumption is thus equal to 4% of crude oil production. The fuel used is generally a straight run distillate, of which about 20% is obtainable from average crude.

This type of distillate is widely used as cracking stock, and owing to the demand for increased quantities of gasoline and the desire to improve the anti-knock value of that product, the use of cracking plants is extending. The economic effect of this situation is to create an interlocking basis of evaluating furnace oils and cracked gasoline, whereas it would appear that the oil burner should compete for its fuel with fuel oil uses. For this reason it is suggested that burners should be designed to operate on cracked gas oils which have few outlets except as fuel oils. Such oils can be made with boiling points identical with those of uncracked furnace oils and with a low viscosity and freedom from coke or foreign matter. The cracked product would possess a higher gravity, a higher ratio of carbon to hydrogen and a greater calorific value per gallon. The variation in air requirement per gallon of oil for complete combustion might be as much as 10%.

The essential elements of a burner designed for cracked oils are: proper atomization, complete mixing with an adequate supply of combustion air, a heated refractory lining and positive control of draft conditions. Other important requirements are: efficient heat recovery, prevention of odour and noise, and freedom from mechanical difficulties. Owing to the rapidly growing demand for oil burners, close co-operation between the petroleum and oil burner industries is urged.

R. A. E.

195. Modern Methods of Wood Preservation. G. Gunn. *J.S.C.I.*, 1932, **51**, 1072–1074.—A brief history of the development of wood preservation is given. Petroleum products used include Diesel and furnace oils, heavy natural oils, montan wax, etc. Natural oils have only slight antiseptic properties, but the wood cells become filled with bitumen, thus excluding moisture. Both fuel oil and montan wax are used in admixture with creosote, the latter providing the toxic action while montan wax seals the pores.

The use of creosote and of many inorganic salts is also discussed, the preservative properties of the former being due to phenoloids and tar bases, and not to the tar acids and naphthalene.

C. C.

196. World Gasoline Trade. A. E. Mockler. *Oil and Gas J.*, 3.11.32, **31** (24), 13.—The production, imports, exports and consumption of gasoline in the principal countries of the world in 1931 are tabulated. Total production was 561,396,000 brls. exceeding consumption by 5½ millions brls. The world

market is considered as divided into four zones, *viz.*, N. American, S. American, European and Oriental, and an analysis is given of the trends in the consumption, production and importations of each zone. Production and consumption totals are undergoing major revisions as a result of protective legislation which is fostering the construction of refineries in consuming countries, and the enforced use of gasoline substitutes and blends in many important consuming countries. R. A. E.

197. Wetting, Spreading and Emulsifying Agents for Use with Spray Fluids. IV. Miscible Oils. R. M. Woodman. *J.S.C.I.*, 1933, **52**, 4T–6T.—A miscible oil is a solution of an emulsifier, usually soap, in the oil to be emulsified, the solution giving an emulsion on stirring with water.

Ovicidal washes for winter use may be coal-tar fractions or high-boiling petroleum oil in an emulsified form, or mixtures of emulsions of both. For summer use, petroleum oils with not less than 98% unsulphonated residue (of Iodine value $<1{\cdot}0$) must be employed, but the unsulphonated residue may be as low as 50% for winter spraying. Tetralin and Dekalin have been suggested as substitutes for petroleum and their use is discussed. Pure compounds are more readily reproduced than the complex petroleum mixtures.

As an aid to dissolution, fusel oil has been put forward in place of phenol, and the miscible oil-forming tendency of various mixtures of fusel oil and soft soap has been measured (using a special spindle oil). The optimum mixture contained 100 g. moist soap and 50 ml. fusel oil ; 17 ml. of spindle oil could be added to 8 ml. of the above mixture before turbidity resulted, and a 15% emulsion of this in water was satisfactory.

The effect of incorporating resin oil and water has also been studied.

C. C.

198. Use of Bitumen to Exclude Noise and Vibration. R. Plumecke. *Bitumen*, 1932, **2**, 174–179.—Work has been carried out in Germany on the preparation of suitable material for insulating buildings, etc., from noise and vibration.

Bitumen alone and in conjunction with various other common products has been found to be particularly valuable for this purpose.

The problems involved are discussed and details are given of some of the materials which have been investigated. These include : a bitumen-impregnated cardboard in corrugated form ; matting composed of sea grass, coconut fibre, straw, etc., between two layers of kraft paper or paper impregnated with asphalt ; a combination of bitumen, cork and felt, forming bitumen-cork-mat ; bitumen and cork in the form of plates ; peat slabs coated with bitumen ; cork dust and bitumen, etc. Tests on some of these products are given, while the ways in which they are used are described and illustrated. C. C.

199. Combustion Chambers of I. C. Engines of the Liquid Fuel Injection Compression Ignition Type. H. R. Ricardo. E.P. 384,674. App. 11.6.31.—The combustion chamber described has an elongated or trough like form with the width at the centre considerably less than at the two ends and the depth preferably constant. This results in a chamber consisting of two lobes connected by a narrower part lying between them. One side of the combustion chamber is open to the cylinder and a fuel injection device situated at one end of the chamber delivers fuel towards the connecting neck between the two lobes.

The exhaust valves, if there are more than one, or the inlet valve and exhaust valve may conveniently be placed one in each lobe. J. G. W.

200. Removing Carbon Deposits from the Cylinders of Internal Combustion Engines. Ethyl Gasoline Corpn. E.P. 384,815, 15.12.32. Appl. 22.12.31.—The invention relates to an improved form of container for liquid carbon remover such as a mixture of furfuryl alcohol and xylene.

The features are that a measured charge of carbon remover, about 20 cc. per cylinder, is sucked into the induction manifold when a conveniently situated valve is opened, and that sealed cans of the carbon remover can be inserted into the container and opened in place, thus avoiding spilling.

J. G. W.

See also Abstract No. 161.

ABSTRACTS.

Class 100. Geographic Occurrence.

201. Argentine Petroleum Industry and the Effects of Nationalisation Policy. M. C. Malamphy. *Oil Weekly*, 16.1.33, **68** (5), 14.—This paper gives the history of National oil development in the Argentine and then deals with the geological investigations. It summarises published information on the various fields, and then goes on to describe geophysical results in various areas. On the Campo Duran anticline faulted structures were indicated, and in Eastern Salta there was evidence in several localities of a buried ridge. In Southern Bolivia there are some oil indications, and the discovery of a partially closed structure gives promise of new developments. At Comodoro Rivadavia the results of seismic, gravimetric and magnetic surveys were unsatisfactory, owing to the numerous irregularities and minor faults. A very full bibliography completes the paper. P. A. S.

202. Petroleum Possibilities in Brazil. *Petr. Times*, 1933, **29**, 148.—In Brazil igneous rocks are little in evidence and the sedimentary formations are mainly Devonian, Carboniferous, Permian, Mesozoic and Tertiary. A north-south line from San Luis to Porto Alegre passes through Triassic, Upper Permian, some Carboniferous and Devonian, and there are indications of petroleum in this belt. The character of the Brazilian coal deposits points to the presence of oil, and in the south there are large accumulations of bituminous shale in the Permian and Triassic, as well as oil seeps. The island of Joas Thania in the River Marahú possesses rich peat deposits, and traces of oil have been verified in the dioritic intersections of the shale. Oil shale is also known in the Araripe mountains. G. D. H.

203. Notable Oil Concessions in Columbia. L. Valette. *Oil News*, 1933, **33**, 70.—The oldest beds, possibly Mesozoic, having been deeply metamorphosed, the lower Cretaceous is the first formation which can be accurately dated. Certain series are very constant throughout the entire middle and lower basin of the Magdalena: The Giron Series (Hauterivian), the La Villetta Series (Barremian, Aptian, Albian) and the Guadalupe and Guadas of the Upper Cretaceous. All are concordant. The origin of the Magdalena oil is attributed to the great thickness of the La Villeta limestone and dark, bituminous shale. The Honda series (Tertiary) of porous sandstone, alternating with marls and plastic clays, is of most importance. The Cretaceous is covered by this series in the Lower Magdalena and Tenerife districts; this is the centre of the petroliferous area.

The basin of the Lower Magdalena is bounded on the north by the coastal zone of the Caribbean Sea and the Serra Nevada de Sante Marta. Surface shows are important on the eastern border, *e.g.*, asphalt bearing rocks 500-600 m. thick occur in the Eastern Cordilleras; on the western margin also the slopes of the Central Cordilleras have asphalt and oil seeps. The Magdalena is a vast basin with the characteristics of a geosyncline, and locally there are secondary anticlines which appear to possess the features essential to the preservation of oil. G. D. H.

204. Crude Oils of Austria. Anon. *Tag. Ber.*, 21.12.32.—In a paper read before the Mineral Oil Group of the Verein Osterreichischer Chemiker, Prof. Dr. Suida discussed the economic and technical importance of the Zistersdorfer oilfield in lower Austria.

The oil is a heavy asphalt base crude, practically free from wax and hard asphalt, and contains no gasoline fractions. It yields 30% of solar oil which

can be cracked to provide gasoline. On concentration to 15/20% an asphaltic residue of high viscosity and adhesivity containing little hard asphalt, but having a large resin content and particularly suitable for use in road construction, can be obtained. The crude can also be reduced to a residue suitable for axle oil, for which there is a large demand, or can be worked up to yield 40% of serviceable machine oil and an equal quantity of cylinder oil.

The crude oil contains about 7½% of emulsified water, which is reduced to 3½% on standing. Full analyses of the crude oil and the products obtained from it in a laboratory distillation are given. The more important of these are as follows: *Crude Oil.*—S.G. at 20° C. 0·9398; Fl. pt. 126° C.; Set. point, fluid at −20° C.; Visc. at 20° C., 65·57° E, at 50° C., 8·9° E; wax content, 0·20%; hard asphalt, below 0·01%; Goudron value, 41%; Engler distillation, I.B.P. 228° C., 2% to 250° C., 11·5% to 300° C., 33% to 350° C. *Heavy Kerosine* (refined).—Yield 12·5%; S.G. 0·882; I.B.P., 208° C., 95% to 300° C. *Heavy Gas Oil.*—Yield 23·0%, S.G. 0·9062, I.B.P., 295° C., 65% to 350° C.; Setting point, below −20° C.; upper cal. value, 10,587 cal./grm.; Visc. at 20° C. 3·43° E. A more suitable gas oil can be obtained by taking off the first 27% from the crude oil. *Normal Gas Oil.*—Yield 27·0%; S.G. 0·8945; I.B.P., 232° C., 84% to 350° C.; Setting point, below −20° C.; upper cal. value 10·652 cal./grm.; visc. at 20° C., 1·68° E.

A series of lubricating oil fractions were prepared by distilling the residue with superheated steam, but the results in the case of the heavier oils were vitiated by cracking. The viscosities curves of the oils could not be regarded as ideal. The setting points were low, and the oils could generally be regarded as of medium quality.

The residual asphalt, representing 15%–20% of the crude oil had a S.G. of 0·980 (owing to its high oil content) and hard asphalt 0·6%. Its viscosity, adhesivity and wax free nature render it particularly suitable for road construction. By topping about 10% and blending with 10/15% of medium oil distillate the flashpoint of the crude is increased to 150° C., and its viscosity reduced to 7/9° E at 50° C., rendering it quite suitable for use as axle oil.

C. L. G.

205. Extending the Aznelt's Oilfields. Anon. *Petr. Times*, 1933, **29**, 115.—Geological data show that the sand content of the horizons which are productive of oil decreases to the west and south-west of the oilfields, and so is considered to diminish the chances of finding oil west of Apsheron. But conditions are considered more favourable on the eastern part of the Apsheron Peninsula, as the formations in question show more sand south and east from the old fields. In addition to a suitable reservoir rock, a big anticline has been located along the whole coast-line. Gas has also been obtained in shallow wells at Gioorgiani; and at Zoogoolbi and Boozooni there were brief but extensive submarine gas eruptions. Favourable structures have been located at Toorkiani and Gioorgiani by electrical methods. G. D. H.

See also Abstracts Nos. 208, 217, 224 and 256.

Class 200. Geology and Origin.

206. Development of Hydrogen Porosimeter. C. J. Coberly and A. B. Stevens. *Oil Weekly*, 23.1.33, **68** (6), 17.—The Porosimeter is an apparatus designed to measure the effective porosity of sands. It consists of an upper and lower chamber with a stop-cock in the connecting tube. The upper chamber has a pressure valve and inlet tube for introducing gas.

The sample to be tested is placed in the lower chamber, flushed with hydrogen gas and brought to atmospheric pressure. The valve connecting

the two chambers is now closed and the pressure in the upper chamber is brought to P^1. The valve is opened and the final pressure P^2 is noted. The effective porosity Vx is found by the formula :—$Vx = a - b \frac{P^1}{P^2}$, where a and b are constants for the apparatus. P. A. S.

207. Importance of Natural Gas in an Oilfield. A. Pleniceceanu. *Ann. Min. Roum.*, 1933, **16**, 67–69.—The author points out that a total extraction greater than 25% of the crude actually present in the reservoir is rarely attained to-day. In order to improve on this figure, it is essential that the forces opposing the flow of oil into a well should, wherever possible, be minimised. In this direction the intelligent control of natural gas is vital. By maintaining a gentle pressure gradient in the producing sand, the obstruction to flow caused by excessive liberation of gas from solution is avoided; further, the retention of this gas within the crude greatly reduces its viscosity. An appeal is made for co-operation in securing efficient oil-gas ratio control, and in the abolition of excessively close spacing of wells, in the Rumanian fields. A. L. G.

208. Magnetic Vector Study of Regional and Local Geologic Structure in Principal Oil States. W. P. Jenny. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1177–1203.—The paper gives a summary of the magnetic anomalies in the States of Louisiana, Texas, Arkansas, Oklahoma, Kansas, Mississippi, Alabama, and California. A series of maps are given in which the local magnetic vectors of the Godetic Stations are computed by deducting the normal values of the earth's magnetic field from the measurements of each Godetic Station. The results are shown in terms of the horizontal and vertical magnetic intensities by reconstructing vector triangle maps.

As these anomaljes are due mainly to the effect of the upper crust, the maps are claimed to show the broad geological features, either petrologically or structurally, of the regions. It is claimed that these vector maps indicate the areas of interest for further magnetometer surveys and indicate the amount of detail required.

A general regional map of the United States on which the main regional magnetic anomalies are summarised, epitomises the information available. V. C. I.

209. Application of Reflective Seismograph. E. McDermott. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1205–1211.—The paper deals with a survey, by reflection seismograph, of the area north of the Mexia-Powell fault-line fields of Texas. Diagrammatic cross-sections, placed in conjunction with typical reflection records, illustrate the manner in which data was obtained. The Pecan Gap formation, and a basal member of the Austin Chalk, served as reflection horizons throughout the area, and contour maps on both these surfaces are given. These locate a number of faults, on two of which closure is indicated. A. L. G.

210. Use of Record Character in Interpreting Results and Its Effect on Depth Calculation in Refraction Work. T. L. Allen. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1212–1220.—This paper draws attention to the fact that the character of the seismic wave depends on the various strata through which it passes and a study of wave character is an important clue to the interpretation of results. A case is described in which two geological horizons of slightly different velocity of wave transmission gave a distinctly different wave form. By making use of this difference the two horizons could be differentiated.

211. Seismic Weathered or Aerated Surface Layer. O. C. Lester. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1230–1234.—The object of the paper is to offer an explanation for the low velocity characteristic of the comparatively thin surface layer, known to geophysicists as the "weathered layer." The layer rarely conforms in depth with the geological weathering of the area, and is almost universally present, regardless of the nature of the surface deposits. Theoretical calculations, supported by such practical data as is available, suggest that the mixture of free air with surface materials is the cause of this phenomenon. The writer therefore suggests the substitution of the term "aerated layer" for "weathered layer." A. L. G.

212. Accuracy of Determination of Relative Gravity by Torsion Balance. D. C. Barton. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1235–1249.—After summarising the comparative result of torsion balance and pendulum in various parts of Europe the paper discusses the results disclosed by torsion balance survey in 45 traverses, mainly in the Gulf Coast Region. The probable error of each individual station in those traverses with a large station interval is given as $\pm 1{\cdot}9$ Eotvos units, while that for the traverses with a small interval has an average of ± 5 Eotvos. In the latter case the greater margin of error is compensated by the smaller station interval. For the whole 45 traverses the probable error of relative gravity determination averages out at 0·4 milledyne per 10 kilometres of traverse.

In the use of pendulum determinations as supplementary data to check the torsion balance results, there is a minimum interval at which these determinations should be placed. Below this interval torsion balance determination is more accurate than the pendulum. This interval has been reduced by improvements in modern pendulum observations and varies now from 8 to 50 kilometres. V. C. I.

213. Curvature of Equipotential Surfaces. M. M. Slotnick. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1250–1259.—This paper gives a simple mathematic conception of the curvature of the equipotential surfaces due to a gravitational field, in an attempt to convey a clear physical picture of the quantities involved to those unfamiliar with abstract mathematics. V. C. I.

214. Advance in Technique and Application of Resistivity and Potential Drop-Ratio Methods in Oil Prospecting. C. A. Heiland. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1260–1336.—The application of electrical methods of prospecting to oil exploration is not so obvious as its usage in the discovery of ore-bodies, and has necessitated specialised technique and a more thorough perfection of the instruments.

The paper gives a summary of the known resistivity and surface potential methods. It discusses the factors affecting the resistivity of rock formations, particularly the water content, and then goes on to describe the laboratory and field methods of its determination. Next the possible electrode arrangements are dealt with both for mapping and for coring, and the instruments and power requirements.

Lastly, the interpretation of results receives critical attention. The Potential Drop-Ratio methods then receive attention in the same way. The last section of the paper gives examples of the use of each method in surveying and correlation, and discusses the possibility of direct location of oil. V. C. I.

215. Use of Geoelectric Methods in the Search for Oil. O. H. Gish. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1337–1348.—Although general opinion has tended to become prejudiced against the use of geoelectric methods of

oilfield prospecting, this probably results largely from the attractions they offer to the incompetent or unscrupulous, self-styled geophysicist. Further, although long employed for the detection of ore-bodies, electrical methods have only been adopted for oilfield work at a comparatively recent date, and the greatly increased potential sources of error were not fully realised at first. The author points out the principal sources of error for the resistivity method, and suggests measures for their elimination. Although electro-magetic and resistivity methods have shown considerable promise in the field, the data now available is not considered sufficient for reliable comparison of these with the gravimetric or seismic methods, on a cost results basis. A. L. G.

216. Correlation between Radon and Heavy Mineral Contents of Soils. R. W. Clark and H. G. Botset. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1349–1356. Practical experiments to determine the value of measuring the radon contents of soils, as a means of locating oilfields, are described. Tests reveal that the source of the radon lies in the radio-active minerals of the soil, quite independent of the presence of petroleum at depth. Thus the usefulness of the method would appear to be confined to the detection of formation contacts, or faults, where a difference in heavy mineral character and content between two formations in juxtaposition is probable. In this connection a danger of misleading interpretations arises through the possibility of local variations in radio-active mineral content within a single formation. A. L. G.

217. Magnetic Resurvey of Oklahoma City Field. O. C. Clifford. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1171–1176.—The results of two magnetometer surveys, one made in December, 1927, before the discovery of oil, and one in January, 1932, after production had reached maturity, are compared. In general, the dominant features and maximum closure are approximately the same in both, but in the more recent survey the contours are closer together, and the structure appears to be tilted towards the west. Any marked discrepancies are thought to be due to changes in the magnetic field brought about by the exploitation of the area. A. L. G.

218. Seismological Discovery and Partial Detail of Vermilion Bay Salt Dome, Louisiana. T. L. Allen. *Bull. Amer. Assoc. Petr. Geol.*, 1932, **16**, 1212–1229.—The discovery in 1927 of the Vermilion Bay Salt Dome of Louisiana resulted from one of the first attempts to survey water-covered areas by seismograph. The organisation and equipment employed in prospecting by refraction-fan method are described, and the original interpretation of results discussed in the light of knowledge furnished by subsequent drilling. A. L. G.

Class 300. Development and Production.

219. Gun-Barrel Heater for Treating Emulsions. Anon. *Petr. Eng.*, December, 1932, **4** (3), 55.—A description is given of a simple heating plant which can be installed in the field for treating emulsions. It consists briefly of a gun barrel containing the emulsion, in which is placed a sloping coil through which steam from a boiler circulates, condenses and returns to the boiler by gravity. Full details of the construction of the heater from usual field equipment are given, together with some operating details.

The heater described has been in operation for a year without giving any trouble. The indirect system of heating removes the difficulties usually caused by the scaling effect of salt water on direct-fired heaters. C. L. G.

220. Integration and Pulsating Errors in Measurement of Quantities of Gas Flowing through an Orifice. D. Gilmour. *J. Inst. Petr. Techn.*, 1933, **19**, 25–68.—A discussion on the measurement of gas by orifice meters with regard to the errors arising from irregular and vibratory flow. Methods of computing these errors are described, and the means adopted for their reduction are explained. G. R. N.

221. Patents on Drilling Apparatus.—L. C. Tilbury. U.S.P. 1,892,912, 3.1.33. Well screen, consisting of two tubes with hard granular material between. Inner tube is formed of detachable sections.

C. D. Rubel. U.S.P. 1,893,151, 3.1.33. Pneumatic displacement pump.

A. E. Carlson. U.S.P. 1,893,224, 3.1.33. Well reaming tool.

L. E. Black. U.S.P. 1,893,487, 10.1.33. Adjustable bottom hole choke for oil wells.

M. F. Aloi. U.S.P. 1,893,693, 10.1.33. Rotary underreamer.

E. S. Durward. U.S.P. 1,893,934, 10.1.33. Adjustable bottom hole flow bean.

F. F. Hill. U.S.P. 1,894,039, 10.1.33. A rotatable drill stem with bit driven from inside of the stem and a speed step-up transmission interposed between the inner end of the main stem and the bit.

C. F. Dougherty. U.S.P. 1,894,212, 10.1.33. Casing shoe attachment.

C. Schlumberger. U.S.P. 1,894,328, 17.1.33. Electrical device for the determination of specific resistivity.

W. L. McLaine. U.S.P. 1,894,519, 17.1.33. Drill pipe protector.

H. C. Otis. U.S.P. 1,894,912, 17.1.33. Process and apparatus for inserting tubing in wells.

J. A. MacReady. U.S.P. 1,894,995, 6, 7, 8, 9, 1,895,000 and 1,895,001, 24.1.33. Core drill and means for ascertaining dip.

B. S. Minor. U.S.P. 1,895,132, 24.1.33. Scrubbing device for oil-well tubing.

J. J. McCullough. U.S.P. 1,895,227. Rotary jar. L. V. W. C.

Class 400. Transportation, Storage and Distribution.

222. Soil Corrosion Survey as Aid in Selecting Proper Type of Coating. W. Denman. *Oil and Gas J.*, 22.12.32, **31** (31), 12.—The methods used in determining the corrosivity of soil towards pipe lines are outlined, and the probable mechanism of the corrosion of iron discussed. The selection of coatings to suit the particular type of soil met with in different sections of the terrain, rather than the use of one general type of coating for the whole line is recommended.

The ideal non-corrosive soil has a high electrical resistance, no acidity, is coarse textured and well drained.

The methods employed in corrosion surveys are (1) electrical, (2) chemical, and (3) soil survey methods. Although high moisture and soluble salt content result in low electrical resistance, no method of determining soluble salt content from the electrical conductivity has been found. Soil survey methods reveal physical conditions, particle size and drainage, but are frequently very difficult to apply.

Electrical Methods.—It is important to know the resistivity of the soil, since the pipe tends to accumulate currents in areas of high resistivity and to discharge them in regions of low resistance, the pipe becoming anodic to the soil and undergoing extreme corrosion.

The most convenient method of determining the soil resistance in the

field is the Shepard meter (*Bur. Stand. J. Res.*, 1931, **6**, 683). The Putnam apparatus (*Proc. A.P.I.*, 1930, Section 4, 122–129) also gives good results, but can only be used in the laboratory.

In acid soils with high electrical resistance to corrosion can be very severe, owing to electrochemical action. Whitney (*J. A.C.S.*, 1903, **25**, 394) suggested that the corrosion of iron resulted from the solution of iron with the consequent formation of ferrous iron, hydrogen ions being liberated from the water until they polarise the iron, at which point the reaction practically stops. In alkaline regions (p_{H_2} to p_{H_7}) hydrogen is removed by interaction with oxygen to form water, while in acid it is liberated as gas, in each case the polarisation of the iron being removed.

The value for total soil acidity, representing the ionised and unionised hydrogen, determines the extent of reaction, *i.e.*, concentration of reacting substances, whereas the p_H value determines the rate of reaction.

Denison's method (*Bur. Stand. J. Res.*, 1931, **7**, 631) of determining the pH values of soils is recommended.

Chemical Methods.—Moisture content is of the greatest importance, whereas a full chemical analysis may be valueless, since soils of very similar chemical composition can vary enormously in corrosivity, depending solely on the moisture content.

Soil Survey.—Examinations should be carried out and the following features noted: (1) Continuously wet areas—stream or marsh land; (2) low areas—washes and draws, or depressions and water holes; (3) general topography, including contours, with degree and direction of slope; (4) drainage; (5) use of land—cultivated, irrigated or fertilized, pasture or waste.

From the above data a fairly accurate survey of soil corrosivity can be determined. Another important question is that of soil stress action. Sandy soils, swamps and marshes are without much action, whereas heavy clay soils are damaging. External shields should be used to protect lines against soil stress action.

The selection of the pipe coating to suit the type of soil met with is particularly stressed. Where the type of soil changes very rapidly it is best to use a heavy uniform coat over the whole of the area. Such types of soil are generally very localised. C. L. G.

223. **Rapid Method for Cleaning Large Storage Tanks.** W. F. Lowe. *Nat. Petr. News*, 4.1.33, **25** (1), 24.—A rapid and safe method of cleaning out the bottoms of large storage tanks is described.

In the first place an opening of convenient size is cut in the side of the tank at the bottom. Two stakes are set 140 ft. apart on either side of the opening and in a line at right angles to a diameter of the tank through the opening. A snatch block is fixed to each stake, to each side of the opening, on the inner wall of the tank opposite the opening, and at a convenient number of points round the wall of the tank on the inside. A rope is threaded through the snatch blocks attached to the stakes, through that block on one side of the opening, through those on that side of the tank, to the one opposite the opening and so to the block on the other side of the opening.

A scraper, consisting of two pieces of wood hinged in the form of a V, is fixed to the rope between the opening and the block opposite the opening. The scraper is then moved back and forth by means of a tractor fixed to the rope between the two stakes. The area swept is then changed by removing the rope from the block opposite the opening to another further round until the whole floor has been swept. It is claimed that in such a way cleaning time is cut down to 2–3 days, and the number of men required to one beside the tractor driver. H. G.

Class 500. Properties and Their Determination.

224. East Texas Crude Gives High Gasoline Yield. A. W. Trusty. *Petr. Eng.*, Jan., 1933, **4** (4), 34.—East Texas crude has the advantage of yielding a high percentage of straight-run gasoline with a very low sulphur content, a good odour and negative to corrosion, and slightly positive to doctor test, but this may be rectified by spraying NaOH solution into the rundown lines. The volatility is adequate for summer requirements and for winter motor fuel, much less natural gasoline is required than for most other straight-run gasolines. The crudes from different parts of the field,—Joiner, Kilgore and Longview—and which are classed as intermediate or mixed base, are very similar, yielding on an average 36% of 410° F. f. pt. gasoline, 8% of 41° A.P.I. kerosine, 46% of gas oil and 9% of 11° A.P.I.residue. Vacuum distillation of the residue, after removing gasoline and kerosine, yields 16% gas oil, 16% lubricating oil dist. and 23% of 16° A.P.I. residue. Characteristics of the gas from Lathrop No. 1 well and of gasolines of various end-points are given. The comparatively good anti-knock value of the straight-run gasoline is due to the large content of naphthene hydrocarbons (30%), there being only 3% of aromatic hydrocarbons. Aniline numbers of 5% fractions from the crude indicate that the gasoline and kerosine fractions are composed of paraffin and naphthene hydrocarbons, while as the fractions become heavier, the content of wax increases and the percentage of naphthenes decreases. Full analyses of painters naphtha, Stoddard solvent and of 41·5° A.P.I. kerosine and 39° A.P.I. kerosine, gas oil and various grades of fuel oil from East Texas crude are given. A feature of the gas and fuel oils is the high pour test, this being 75° F. in the case of the gas oil and from 75° F. to 90° F. in the case of the fuel oils.

The properties of the products given by the cracking of East Texas residuum after removal of gasoline and kerosine, in a tube and tank unit under 350 lb. pressure and 900° F. transfer temperature are quoted (see also, Abstr. No. 490/1931). Treatment of the distillate with 4 lb. of H_2SO_4 and rerunning to 400° f. pt. gave a gasoline of low sulphur, low gum and 65 octane number. C. L. G.

225. Rapid Estimation of High-Boiling Constituents of Benzines, etc. J. Tausz and A. Rabl. *Erdöl und Teer*, 1933, **9**, 43–45.—A method is described for estimating the rate of evaporation of liquids. It is claimed to be particularly applicable to fuels and solvents, and is said to yield as much or more information than the conventional Engler distillation. Moreover, only a very small quantity of liquid is required.

The only apparatus required is a special type of micro-balance, the weights on which are recorded by the turning of a graduated disc. A 10–12 sq. cm. triangle of filter paper is suspended by a corner from the balance arm, and counter-balanced by a rider. One-tenth of a ml. (or 0·1 gr.) of the liquid to be examined is placed on the filter paper by means of a capillary. Weighings are made at intervals of, say, half a minute, and the weight of the residue plotted against the time of evaporation. Data is tabulated for a number of benzines and chemical compounds, such as water, alcohol, dekalin, ketones, aromatics, etc.

Heavy residues are thus detected; very light constituents often evaporate before even the first weighing is made. For pure compounds the greater part of the curve is linear. E. B. E.

226. Vapour Pressure of Crystalline Benzene and Cyclohexene. V. R. Deitz. *J. A. C. S.*, **55**, 472.—The vapour pressures of benzene and cyclohexene have been measured in the crystalline state at various temperatures by employing a modification of the Knudsen method of measuring vapour pressures. Analysis of the experimental results indicates that the experimental errors involved lead to a probable error of 4% in the recorded vapour pressures. H. E. T.

227. Polarity in Certain Hydrocarbon Vapours. K. B. McAlpine and C. P. Smyth. *J. A. C. S.*, **55**, 453.—Accurate measurements of the dielectric constants of gases and vapours have been carried out, the apparatus used being tested by repeated measurements upon air and carbon dioxide. The dielectric constants of benzene, toluene, propane and propylene have been measured, and the values obtained have been used to calculate their polarisations and electric moments. The dipole moments were calculated from the Debye equation. Benzene and propane showed no change in their polarisations with rise in temperature, indicating that the increase previously observed in a number of liquid paraffins is due to decrease in intermolecular action. The zero moment found for the benzene molecule agrees with the less accurate results of the measurements upon the liquid, and with the symmetrical structure of the molecule; while the zero moment found for propane is consistent with the absence of moment in the higher members of this series of hydrocarbons. Any polarity in the C-C bonds is too small for detection by means of the electric moment. The small electric moments found for toluene and propylene are of the same order of magnitude as those which might arise from inductive effects in the molecule. H. E. T.

228. Demulsification of Mineral Lubricating Oils. Part II. L. Hemmer. *Ann. des Comb. Liq.*, 1932, **7**, 859–877.—The work of Weiss and Vellinger (*Ann. des Comb. Liq.*, 1929, **4**, 653) demonstrated that the curves relating the interfacial tension of mineral oils and the p_H value of the aqueous phase could be classed in two categories, viz., those parallel to the p_H axis and those which plunged rapidly towards the p_H axis at high values of p_H. Similar curves are obtained when emulsibility is plotted against p_H. In general, the former increases the less the degree of refining, well refined oils giving curves parallel to the p_H axis and badly refined oils the second type of curve. The addition of 0·05% of oleic acid to a well refined oil, degraded it from the first to the second category, supporting the contention that acidic products are those active in producing emulsions. Ten oils gave interfacial tension —p_H curves identical in shape with those obtained by plotting emulsibility against p_H, and it is suggested that the former property, *i.e.*, S.T., shall be measured and taken as indicative of emulsibility. It is important when comparing the emulsibilities of different oils to reduce them to approximate uniform viscosity and gravity, as these properties affect emulsibility. To accomplish this, the author dilutes samples of oil with xylene and petroleum ether mixtures. The paper is copiously illustrated with graphs dealing with fresh turbine oils, used oils, and artificially aged oils (by the Weiss-Salomon method). W. E. J. B.

229. Emulsion Systems containing Phenols, Water and Gelatin. R. M. Woodman. *J. S. C. I.*, 1933, **52**, 44T-46T.—Previous work has shown that gelatin can yield oil-in-water or water-in-oil emulsions with cresylic acid or cresols. In this paper experiments are recorded on cresylic acid (B.P.), liquefied phenol B.P., hexalin and methyl hexalin with 0·4% aqueous gelatin. (The age of the gelatin solution has an influence on emulsification.) All these compounds formed dual types of emulsion under certain conditions.

Various hypotheses which have been put forward to explain the mechanism of dual emulsion formation are outlined. The author suggests that there is a difference in partition of emulsifier between the liquid phases. C. C.

230. Continuous Viscometer. C. D. Miller. *Instruments*, 1933, **6** (1), 2.—The instrument comprises a journal and bearing operating with fixed clearances and at constant temperature. At constant speed, the "wedging" action of the oil between journal and bearing may be measured by the pressure developed in the oil. The pressure is a measure of the viscosity of the oil and is indicated by a liquid column gauge in which the liquid is the oil under test. The column is kept at the temperature of test and on one side is provided with a scale of centistokes and on the other with a scale giving Saybolt seconds, Redwood seconds and Engler degrees, etc. W. H. T.

231. Deviation of Natural Gas from Boyle's Law. T. W. Johnson and W. B. Berwald. *U.S. Bur. Mines*, Tech. Paper 539.—This investigation was confined to various natural gases, at pressures up to 1000 lb./sq. in. and temperatures from 40 to 80° F. Within these ranges natural gas is more compressible than the ideal gas.

The essential parts of the apparatus were the carefully calibrated high-pressure gas cylinder connected with: (1) a source of dry gas at high pressure; (2) a dead-weight gauge; (3) a low-pressure water chamber, and the constant temperature water bath in which the gas cylinder and water chamber were immersed.

The procedure, in outline, was to start a determination with the highest desired gas pressure in the calibrated cylinder and to reduce the pressure by venting gas into the low-pressure water cylinder with measurement of escaping gas by water displacement. This reduction of pressure was carried out in any desired number of stages and each stage provided a point on the deviation curve.

The method of calculation used was as follows:—

if V = total volume of gas then

$$V = W\frac{P_B + H - P_W}{P_O} + C \times \frac{P_B + H}{P_O}$$

where W = total volume of water displaced due to lowering the pressure from P to ($P_B + H$), P_B = barometric pressure, P_O = pressure base, H = pressure on gas in water chamber after volume of water W has been displaced, P_W = vapour pressure of water at temperature of experiment, C = volume of gas cylinder. By Boyle's law, volume of gas in the gas cylinder at its initial absolute pressure reduced to absolute pressure base P_O was: $Q = C \times \frac{P}{P_O}$ where P = initial pressure on high pressure cylinder. Then the percentage deviation from Boyle's law at pressure P was given by

$$n = \frac{V - Q}{Q} \times 100$$

Curves of the deviations are included in the paper and several examples are worked out of applications of deviations found, to gas-engineering problems, such as the measurement of natural gas and estimation of gas reserves.

E. N. H.

232. Estimation of the Knock Rating of Gasoline. A. W. Trusty. *Nat. Petr. News*, 21.12.32, **24** (51), 29.—A discussion of the relation between the chemical composition of a gasoline and its octane number. It is pointed out that the detonating tendency of the various groups of hydrocarbons differs

from one to another, and that for the same group of hydrocarbons the octane number is related to the constitutional formula. Isomerism in the cyclic hydrocarbons, however, does not appear to be of importance. The article is illustrated by a table giving the analyses of a number of gasolines which shows that a high content of aromatics and/or naphthenes is an essential for a gasoline of high octane number. It would appear, however, that the calculated octane number of a blend of gasolines of known octane numbers may be different from the actual determination, and that in general a blend of two gasolines of high octane number gives a figure above the calculated one, while gasolines of low anti-detonating properties give blends with octane numbers below the theoretical. H. G.

233. Rates of Detonation in Carbon Monoxide-Oxygen Mixtures. C. Campbell, C. W. Sitworth and D. W. Woodhead. *J.C.S.*, 1933, **134**, 59-62.—The rates of detonation of various mixtures of carbon monoxide and oxygen have been determined. Detonation was established by introducing around the spark gap, before ignition, a small amount of electrolytic gas or a similar mixture. The flames produced were photographed on a drum camera. The speed-composition curve shows an almost linear increase of speed with increase in the percentage of combustible gas, over most of the detonating range, agreeing with the results obtained for many other detonating gas mixtures. As with hydrogen-oxygen mixtures, the speed appears to depend on the calorific value and density of the gas mixture. H. E. T.

234. Critical Ignition of Explosive Hydrogen Mixtures. J. H. Maas and C. Ewing. *J. Phys. Chem.*, 1933, **37**, 13.—The phenomena of "critical" ignition is shown to depend on the presence of nitrogen in the gas mixtures. Inert gases, such as argon, do not produce critical ignition in explosive hydrogen mixtures. The ignition curve for hydrogen in air mixtures consisted of two distinct steps, while on the other hand smooth curves were obtained for mixtures of hydrogen and oxygen, and also for mixtures of hydrogen, oxygen and argon; the argon being present in the same proportion as in the air mixtures. H. E. T.

235. Effect of Tetraethyllead on Octane Number. L. E. Hebl, T. B. Rendel and F. L. Garton. *Ind. Eng. Chem.*, 1933, **25**, 187.—It is known that, in addition to its anti-knock value, every gasoline has a property which may be defined as its lead susceptibility and which determines the amount of increase in anti-knock value for any given concentration of tetraethyllead. The following given factors determine the octane number of any gasoline treated with tetraethyllead: (1) The effectiveness of iso-octane at different concentrations in raising the anti-knock value of iso-octane and heptane mixtures; (2) the effectiveness of tetraethyllead at different concentrations; (3) the octane number of the base gasoline before addition of tetraethyllead; (4) the lead susceptibility of the gasoline; (5) the number of c.c. of tetraethyllead added per gallon of gasoline.

The change in compression ratio per octane number is related to the octane number according to the empirical equation:

$$\frac{dR}{dy} = 0{\cdot}0005 + 0{\cdot}00025y + 7{\cdot}7 \times 10^{-18} \times y^{7{\cdot}2}$$

where R = compression ratio of any gasoline 7·7 = its octane number. By integration this becomes:

$$R = r + 0{\cdot}005y + 0{\cdot}00013y^2 + 9{\cdot}4 \times 10^{-17} \times y^{8{\cdot}2},$$

where r the integration constant represents the compression ratio of heptane.

As regards factor 2 above, after adjusting the compression ratio increase

vs. tetraethyllead curve for each gasoline to pass through 0·5 ratio at 2·0 c.c. per gallon, the shapes of the curves are practically identical, indicating that this factor is a property of tetraethyllead quite independent of the gasoline with which it is mixed. The equation is then $(R - r_{0.c.c./gall.})_s = 0{\cdot}34N - 0{\cdot}058N^{1.62}$ where N = lead concentration, $r_{0.c.c/gall.}$ = compression ratio of undoped gasoline and subscript s indicates that the quantity $(R - r_{0.c.c/gall.})$ has been adjusted to 0·5 ratio at 2·0 c.c. per gallon.

If S is the lead susceptibility, which is cancelled when all the curves are made to pass through 0·5 ratio at 2 c.c. per gallon, then $R = r + S$ $(0{\cdot}34N - 0{\cdot}058\ N^{1.62})$.

Suppose that for any given gasoline the two octane numbers, y_1 and y_2 correspond to the two concentrations N_1 and N_2 and the corresponding compression ratios are R_1 and R_2, then by combining the given equations:

$$S = \frac{0{\cdot}005\,(y_1 - y_2) + 0{\cdot}00013\,(y_1^2 - y_2^2) + 9{\cdot}4 \times 10^{-17} \times (y_1^{6.2} - y_2^{6.2})}{0{\cdot}34\ (N_1 - N_2) - 0{\cdot}058\ (N_1^{1.62} - N_2^{1.62})}.$$

This equation is considered too complicated for practical use, and a chart is constructed by means of which the lead susceptibility may be obtained directly from test data.

The relatively high susceptibilities of natural and aviation gasolines are remarked upon. When certain gasolines are acid treated, compounds may be formed which render the first few c.c. of tetraethyllead practically inactive. The effect of redistillation of such a gasoline is a marked increase in the lead susceptibility though the lag is not quite reduced to zero. E. N. H.

236. Total Heats of Gas Oils at Elevated Temperatures and Pressures. W. W. Gary, L. C. Rubin and J. T. Ward. *Ind. Eng. Chem.*, 1933, **25**, 178.—In determining heat contents of gas oils at elevated temperatures and pressures, data were collected under conditions comparable to actual operating practice. The operating conditions were: temperature between 700 and 950° F. and pressures up to 750 lb./sq. in. The apparatus consisted essentially of a charge tank, feed pump, gas-fired preheater, electrically heated lead bath calorimeter, cooler calorimeter and control valve all in series. The two sections, heater and cooler calorimeters, produced simultaneous values for the total heats which served as check determinations. To evaluate the heat losses due to radiation and conduction, runs were made at atmospheric pressure: (1) charging water directly to the heater calorimeter; (2) charging dry steam to the preheater. When operating at high temperatures the stock produced was tested for evidence of cracking by fractionation in a true boiling point column and with only two exceptions no evidence of cracking was found.

Four oils were chosen which represented various cracking plant gas oils from Midcontinent type crudes encountered in commercial operation. The total heats of vapours above 32° F. at atmospheric pressure were in excellent agreement with those determined from the equation of Weir and Eaton and the mean specific heats agreed with the equation of Bahlke and Kay. For the liquid total heats of straight-run gas oil the equation of the Bureau of Standards was in closest agreement, but with cracked gas oils considerable deviation was observed. On the basis of these data an equation for total heats of liquid gas-oil cracking stocks from 40° to 15° A.P.I. was developed:

$$H = (15d - 27) + (0{\cdot}7615 - 0{\cdot}400d)\,t + (0{\cdot}000625 - 0{\cdot}000440d)\,t^2$$

where H = total heat above 32° F. B.Th.U./lb.

d = specific gravity at 60° F. and t = temperature ° F.

The authors include a review of the equations of other workers, and the conclusion was drawn that equations for specific heats or total heats of liquid

hydrocarbons, when based on temperature-specific gravity relations, must be limited to stocks of the same general class, no equation, based on these two factors alone, being valid for both straight-run and cracked products.
E. N. H.

237. Autoxidation of Certain Ethylene Oxides. E. P. Kohler and E. M. Nygaard. *J. A.C.S.*, 1933, **55**, 310.—The autoxidation of the oxido alcohol, α,α-diphenyl-β-(hydroxybenzyl) ethylene oxide to a peroxide, appears to consist of first a cleavage to benzaldehyde and diphenylethylene oxide, then autoxidation of the benzaldehyde, and finally synthesis of the peroxide from the autoxidation product of the benzaldehyde and diphenylethylene oxide. In this synthesis the intermediate product is not benzoperacid.
H. E. T.

238. Number of Structurally Isomeric Hydrocarbons of the Acetylene Series. D. D. Coffman, C. M. Blair and H. R. Henze. *J. A.C.S.*, 1933, **55**, 252.—The number of structurally isomeric hydrocarbons of the acetylene series has been calculated from finite recursion formulæ. Two recursion formulæ present themselves according to whether the carbon content of the hydrocarbons is odd or even, and in adapting these formulæ to the calculation of the number of isomers of any given carbon content, the total number of alkyl radicles of N–2 and all lesser carbon contents must be known.
H. E. T.

239. Number of Structurally Isomeric Hydrocarbons of the Ethylene Series. H. R. Henze and C. M. Blair. *J. A.C.S.*, **55**, 680.—By separating the isomeric hydrocarbons of the ethylene series of each specified carbon content into four groups comprising various types depending on whether one, two, three or all four of the hydrogen atoms which may be considered as attached to the >C=C< grouping, are replaced by alkyl groups; a relationship may be established between the number of structurally isomeric homologues of ethylene and the attached alkyl groups.

Mathematical formulæ of the (finite) recursion type are derived which permit of the calculation, from their carbon content, of the number of isomers in each structural type. To use these formulæ for purposes of calculation of the total number of structural isomers for any given carbon content N, the total number of alkyl groups of N–2 and all lesser carbon contents must be known.
H. E. T.

240. Pyrolysis of Alpha Unsaturated Hydrocarbons. C. D. Hurd and H. T. Bollman. *J. A.C.S.*, **55**, 699.—The pyrolysis of the hydrocarbons, diallyl, 4-methyl-1-pentene, allylcyclohexane and 4-phenyl-1-butene has been studied. These hydrocarbons gave a predominating quantity of propylene as a gaseous product of the pyrolysis, but allene was not produced in any case. The liquid products produced pointed to the fact that isomerisation, dehydrogenation and polymerisation processes had occurred. A mechanism for the reactions taking place during pyrolysis is outlined.
H. E. T.

241. System Ethyl Alcohol-n-Heptane at 30° C. J. B. Ferguson, M. Freed and A. C. Morris. *J. Phys. Chem.*, 1933, **37**, 87.—The compositions of the coexistent phases for the system ethyl alcohol-n-heptane has been determined at 30° C. The total pressures have been measured and the partial pressures calculated. No evidence was obtained supporting the curious partial pressure curves obtained by previous investigators.
H. E. T.

242. Mineral Oil Sulphonic Acids. S. Pilat, J. Sereda and W. Szanowski. *Petr. Z.*, 18.1.33, **29** (3), 1-11.—The action of fuming or concentrated

sulphuric acid in the refining of mineral oils produces three series of sulphonic acids which the authors differentiate as α, β and δ acids according to the solubility of their calcium salts in water and ether.

The alpha acid is formed principally in the acid tar and partly in the oil phase and its calcium salts are insoluble in water and ether. The beta acid is present mostly in the oil phase in refining with oleum and in the acid tar. Its calcium salts are easily soluble in ether and insoluble in water. The gamma acids are only produced in the acid tar and the calcium salts are insoluble in ether and soluble in water.

The gamma acids can be separated into two groups, one of which is water soluble and the other yields an insoluble barium salt. Two series of compounds can be isolated from the calcium salts corresponding to the formula $C_nH_{2n}SO_3H$ and $C_{19}H_{38}SO_3H$. A number of derivatives of these compounds was analysed, *e.g.*, the sulphochloride, ester, sulphamide and some phenols.

The acid tars obtained in the refining of lubricating oils of varied origins were found to contain gamma sulphonic acids as one of their components, and this shows that the constituents which are easily sulphonated possess the same or very similar structure. W. S. E. C.

243. Improved Slow-Combustion Gas Pipette. C. H. Bayley. *Canad. J. Res.*, 1932, **7**, 680.—In the usual type of pipette for the combustion of hydrocarbon and other gases by the slow-combustion method, cracking of the pipette and explosions are not infrequent. A new type of slow-combustion gas pipette is described in which these difficulties are overcome. The combustible gas is admitted through a platinum jet and impinges directly on to the platinum spiral, thereby ensuring complete combustion and eliminating the danger of explosion. E. N. H.

244. Experiments on the Pyrolysis of Gaseous Paraffins with Special Reference to the Production of Ethylene. A. Cambron. *Canad. J. Res.*, 1932, **7**, 646.—Natural gas containing 89·7% methane, 4·8% ethane, 3·4% propane and 2·1% higher paraffin, was passed over tungsten spirals heated to 1050° C. and small yields of liquid products were obtained. Even at 1050° C. the life of these spirals was only a few hours and the method was abandoned.

Using the same gas and an electrically heated carbon rod 0·4 cm. in diameter in a silica tube 2·0 cm. wide, 7·7% of the gas was converted into liquid and solid hydrocarbons at a rod temperature of 1050-1100° C. When the silica tube was insulated no liquids or solids, apart from carbon, were formed. Similarly, when the silica tube was replaced by a 3·2 cm. water-cooled Pyrex tube no liquid or solid hydrocarbons were obtained, but 17% of the gas was converted to unsaturated hydrocarbons at 993 and 1050° C. At temperatures above 1200° C. acetylene was produced in greater quantity than ethylene. Within limits, using tubes of 1·92, 3·20 and 3·87 cm. diameter, the volume of the reaction space was without marked effect on the course of the reaction at an approximately constant rate of gas flow.

With ethane, using the 3·2 cm. water-cooled reaction tube, at rod temperature of 985 and 993° C., 50·5% of the entering gas was converted to ethylene, while at 989° C., 90% of the ethane decomposing did so according to the equation :—

$$C_2H_6 = C_2H_4 + H_2.$$

The dehydrogenation of ethane was greatly accelerated by the presence of reduced copper in the tube, used in the form of a cylindrical wire gauze placed round the carbon rod. Copper bronze coated with molybdic oxide was also found to be active under the same conditions. The influence of rod surface was considered and the presence of a shiny film of carbon, formed

by heating the rod in natural gas, increased the rate of production of ethylene. The author suggests that this may not be due to the greater activity of this type of carbon, but is explanable on the grounds of difference in emissivities leading to inaccurate temperature determinations when the shiny carbon is present.

Preliminary experiments with propane and butane (not analysed) are reported. At 970° C. with propane, 70·7% of the hydrocarbon which decomposed on one passage through the tube did so according to the equations:

$$C_3H_8 = C_2H_4 + CH_4\,;\ C_3H_8 = C_3H_6 + H_2.$$

Similarly, with butane, 62·1% of the gas which decomposed did so as follows:

$$C_4H_{10} = 2\,C_2H_4 + H_2\,;\ C_4H_{10} = C_3H_6 + CH_4.$$

E. N. H.

245. Isolation of the Three Xylenes from an Oklahoma Petroleum. J. D. White and F. W. Rose, Jr. *Bur. Stand. J. Res.*, 1932, **9**, 711-720.—Each of the three xylenes has been isolated in a very pure state from an Oklahoma petroleum.

The petroleum after a preliminary distillation in a refinery was fractionated with the aid of efficient columns, and the fractions 127-141° C. collected in 1° C. cuts.

Attempts to further fractionate this cut by crystallisation did not result in sufficient separation, but extraction with liquid SO_2 at —35° C. to —40° C., followed by fractional crystallisation yielded a cut boiling mainly between 138 and 144° C., and consisting essentially of a mixture of the three xylenes.

Further fractionation under reduced pressure yielded two fractions from one of which *o* xylene of high purity was obtained by crystallisation. The other fraction, on crystallisation, yielded a pure *p* xylene and an eutectic mixture of the *m* and *p* compounds from which two samples of *m* xylene were obtained by :—

(1) Alternating fractionation and crystallisation.

(2) Sulphonation and subsequent hydrolysis.

The isolated hydrocarbons were tested for purity by means of freezing curves, and their specific gravity, refractive indices, boiling and freezing points compared with those of the synthetic compounds. Their infra-red absorption spectra were also determined.

It was found that the xylenes were present in the crude oil to the extent of 0·3% and in the proportion of *o* 3, *m* 3, and *p* 1 parts by weight.

D. L. S.

246. Physical Method of Analysis of Mixtures of Gasoline and Alcohol and Gasoline, Alcohol and Benzole. C. Bonnier and G. Juge-Boirard. *Ann. des Comb. Liq.*, 1932, **7**, 799-809.—Most of the physical properties of gasolines vary too much for use in deducing the composition of mixtures of ethyl alcohol and gasoline. A method has been developed, however, based on the amount of water necessary to produce turbidity in a mixture of alcohol and gasoline.

A triangular diagram shows the stability of gasoline-alcohol-water mixtures at 15° C., and two further diagrams give the amounts of water required to cause turbidity in alcohol mixtures of both No. 1 and Commercial grade gasolines. Light gasolines are found to have greater stability to water then heavier ones, when mixed with the same amount of alcohol.

It is found that the curves for water tolerance of gasoline-alcohol blends of stated composition become straight lines if the water tolerance is plotted against the absolute temperature raised to the power of 4·3. The slope of the curves is governed by the concentration of the alcohol in the mixture,

irrespective of the nature of the gasoline. Hence, if the mixture to be analysed is examined for water-tolerance at several temperatures and the points plotted against the absolute temperature to the power of 4·3, a straight line is obtained, and by comparing the slope of this with the standard curves the amount of alcohol in a dry mixture of gasoline and alcohol may be read off. This curve may be below the standard curve if water is present or above it if, say, benzole is present. A known quantity of anhydrous alcohol is then added to the spirit and the determination repeated. The position of the point of intersection of the two straight lines indicates the amount of water in the mixture.

If benzole is present, the above method must be modified: the slopes of the curves are somewhat different. It is hoped to extend the method to cover satisfactorily such mixtures. E. B. E.

247. Natural Gasoline and New Anti-knock Tests. H. M. Trimble. *Oil and Gas J.*, 19.1.33, **31** (35), 16.—A large number of tests have been carried out on C.F.R. and Series 30 engines on samples of various types of gasoline in order to ascertain the effect on the octane ratings caused by increasing the speed of test engines and the temperature of the cooling medium used. The tests in the C.F.R. engine were carried out at speeds and cooling medium temperatures of (*a*) 600 r.p.m. and 212° F.; (*b*) 900 r.p.m. and 375° F., whilst those in the S30 B engine were carried out at (*a*) 600 r.p.m. and 212° F.; (*b*) 900 r.p.m. and 362° F. Other conditions of the tests are tabulated. The results are presented in the form of 3 graphs. The first one shows C.F.R. and Series 30B octane numbers under conditions (*a*) plotted against Series 30B octane numbers under condition (*b*) for samples of ethylised and unethylised natural gasolines having vapour pressures of 7/14·5 lb. (Reid). In the second, C.F.R. results under conditions (*a*) and (*b*) are compared for natural gasolines having vapour pressures of 1·25/10 lb. (Reid). In the third, C.F.R. condition (*a*) results are compared with those of Series 30 B conditions (*b*) for a number of motor fuels obtained from filling stations. The general conclusions are:—(1) C.F.R. (*a*) gives slightly lower octane numbers than Series 30B (*a*) on ethylised and unethylised natural gasolines; (2) on unethylised natural gasolines the octane numbers Series 30 B (*b*) are always lower than Series 30 B (*a*) and C.F.R. (*a*) octane numbers; (3) on ethylised natural gasolines the reverse is generally true; (4) octane numbers C.F.R. (*b*) are slightly lower than those determined by C.F.R. (*a*) on ethylized and slightly higher on unethylised natural gasolines; (5) comparing results by all four test methods, the maximum difference for any given sample of unethylised or ethylised natural gasoline appears to be four octane numbers; (6) comparing results of Series 30B (*b*) with C.F.R. (*a*), unethylised natural gasolines show a smaller average drop in octane number at the higher operating temperature and speed than do unethylised motor fuels, the average difference being about four octane numbers. R. A. E.

248. Volatility Index for Motor Fuels. G. C. Oberfell and R. C. Alden. *Oil and Gas J.*, 19.1.33, **31** (35), 14.—The 10% distillation temperature of modern gasolines is sufficiently low to ensure easy starting at low atmospheric temperatures. The permissible range of the 90% distillation temperature to avoid loss of power and excessive crankcase dilution is wide. Although little can be achieved in the direction of improving present gasolines from these two aspects, much can be done with regard to the mid-portion of the distillation curve. A table shows the reduction effected in the time during which the choke must be used after starting, by reducing the 35% dist. temp. of the gasoline used from 250° F. to 150° F. in stages of 25° F. Engine temperatures of −30 to +90° F. are considered. From data presented by Brown in regard

to mixture temperatures it is concluded that operating mixture temperatures range from 120/180° F. except in extreme atmospheric conditions. From this conclusion and the work of Brooks and Bruce it is deduced that the critical portion of the distillation curve in respect to acceleration under steady driving conditions is that lying between the 35% and 65% evaporated points. This is supported by Brown's generalisations. It is suggested that the 50% dist. temp. is a sufficiently accurate guide to the effective volatility of gasolines, especially since it is shown, by plotting 30%, 50% and 70% evaporated temperatures of a large number of commercial gasolines, that for a given 50% point there are relatively narrow ranges for the 30% and 70% points. Other advantages of using the 50% point are that it appears in many specifications and that it is a simple manufacturing control point. The " average boiling point " determined by the Bureau of Mines and the volatility index incorporated in the specification for Fighting Aviation Gasoline, anti-knock grade, are considered inadequate since the earlier portions of the distillation curve should receive more than average emphasis. A comparison of the relative effectiveness in acceleration of three gasolines, whose 10%, 50% and 90% distillation temperatures are shown, lends further support to the view that reduction of the 50% temperature of a gasoline gives improved acceleration in use. A proposal is made to define the volatility index of a gasoline as the difference between 284 (the maximum permissible 50% temperature for U.S. motor gasoline in °F.) and the 50% evaporated temperature in °F. of the gasoline under test. The minimum volatility indices of the Federal specification gasolines are shown. A blending chart enables one to read off directly the quantity of natural gasoline required to raise the volatility index of a refinery gasoline, having an index ranging between —30 to +40, to the level desired. Commercial advantages attached to the use of the proposed volatility index are outlined. R. A. E.

249. Trend in Motor Fuel Quality. W. T. Ziegenhain. *Oil and Gas J.*, 19.1.33, **31** (35), 20.—Laboratory tests have been carried out on samples of the motor fuels marketed by the major companies in the Middle Western States at the commencement of the year. Analyses of all the premium, regular and third grade gasolines considered in the survey are given, and an average quality of each of the three grades deduced from this data. These average qualities are compared with those obtained from tests carried out on samples of the same brands purchased at the commencement of the years 1931 and 1932. Octane ratings and vapour pressures show a gradual but distinct increase in the case of all three grades. Both the 20% and 50% A.S.T.M. distillation temperatures of regular and 3rd grade gasolines have been progressively reduced, but little change is noticeable in I.B.P. As regards the premium grades, the 20% distillation temperatures tend to rise, whereas the 50% temperatures have been progressively reduced. It is expected that the 50% distillation temperatures of regular grades will be further reduced. The methods by which the improvements in volatility and anti-knock value have been obtained are deduced from consideration of the analyses. The present uses and future possibilities of natual gasolines and cracked gasolines as blending media for refinery gasolines are discussed.
R. A. E.

250. Experiments with Oil-Testing Transformers. Typke. *Erdöl und Teer*, 1933, **9**, 61.—Further experiments have been carried out using the experimental oil-transformers previously described (cf. abst. 587/1932). Various substances have been proposed for addition to transformer oils to lower their oxidation tendencies; the most suitable of the substances appears, from laboratory tests, to be phenyl-α-naphthylamine. Experiments were carried

out on a Russian oil alone and with the addition of 0·5% phenyl-α-naphthylamine. After 3750 hours in the transformer it was found that the oil containing the amine showed a higher acid number and more sludge and a greater deterioration of cotton than did the straight oil. The addition of the amine is thus shown, by transformer tests, to be detrimental to the oil.

Comparisons were also made on the deterioration of Russian and American oils in comparison with the same oils from which half of the sulphur content had been removed. In both cases slightly more deterioration was observed in the partially desulphurised oils. E. B. E.

251. Preparation of Insulating Oils. Typke. *Erdöl und Teer*, 1933, **9**, 29.—It has previously been shown that the addition of a quantity of a moderately refined oil to a white oil can reduce the tendency of the product to oxidise, without giving rise to sludge-forming properties. Further experiments have shown that better results can be obtained by adding, instead of the less refined oil, a small quantity of a methyl alcohol, acetone or sulphur dioxide extract of this oil, containing the protective bodies from the oil.

A few examples of the procedure are given. Thus an American white oil gave a tar-number of 3·7 and no sludge. When 100 grs. of this oil and 50 grs. of an American spindle-oil distillate were mixed, the product gave a tar number of 0·34 and a sludge value of 0·09%. If, however, 150 grs. of the white oil were treated with 0·75 grs. of an extract obtained from 50 grs. of spindle-oil by extraction with methyl alcohol, the tar number of the mixture was 0·02 and there was no sludge formation. E. B. E.

252. Heavy Gears Cause Special Lubrication Problems. O. C. Bridgeman. *Oil and Gas J.*, 17.11.32, **31** (26), 50.—Modern tendency to increase h.p. transmitted without corresponding increase in the size of gears has resulted in higher pressures between parts moving relative to one another and necessitated the use of lubricants capable of sustaining higher loads than will ordinary mineral oils. The problem involves an investigation of the relation between design factors, operating conditions and lubricant characteristics. The design factors of interest are: (1) Dimensions of gears; (2) tooth design; (3) gear material; and the operating conditions of interest are: (1) Speed (peripheral); (2) load, especially the pressure in lbs.-sq. in. of area of contact; (3) operating temperature. The influence of each of these factors is discussed. The four characteristics which define extreme pressure lubricants are: (1) load carrying capacity; (2) tendency to cause or prevent wear; (3) corrosiveness; (4) stability or permanence. The effectiveness of an extreme pressure lubricant appears to depend on the presence of materials in the oil which will separate out readily or react readily with the metal to form a load-carrying film. A degree of activity is thus desirable, but instability in the direction of separation of the active constituent before or during service is not. The activity of the lubricant is probably a marked function of temperature. The development of a test apparatus and procedure for lubricant characteristics which will be significant as regards performance in service is necessary, and in order to evolve such a test a complete study of the effect of all the fundamental variables must be undertaken. A joint committee of the U.S. Bureau of Standards and the S.A.E. decided to commence with a study of the load carrying capacity, which is of prime importance. Nine samples were tested on four lubricant testers, and the relative loads at time of seizure for each oil are listed, Oil No. 1 being taken as unity in each case. Only two of the machines give results in good agreement, but investigation showed that these variations can be explained by differences in (*a*) metal; (*b*) rubbing speeds; (*c*) rate of heat conduction. No information is given by the testers on pressures at the time of seizure

since the area of contact is unknown, due to rapid wearing under the test conditions. A certain amount of information on the effects of speed and temperature, and on coefficients of friction at varying speeds obtained during the course of the tests, is shown in the form of graphs and is discussed. The work is now being continued with two of the testers, using the same oil samples in order to study the effects of the variables indicated. Hypoid and worm gears are being installed for the tests. R. A. E.

253. Sulphur Content of Insulating Oils. P. Nowak. *Petr. Zeit.*, 11.1.32, **29** (2), 1–7.—Free sulphur, hydrogen sulphide, carbon disulphide, mercaptans, sulphides, disulphides, thiophene and thiophane are found in insulating oils. The application of different methods of determination of these compounds is discussed and Rothe's method is considered to be the most suitable. This method consists in heating 5–8 gms. of the oil with nitric acid and magnesium oxide for 2–3 hrs. The acid is then evaporated, the residue taken up several times with nitric acid, and after evaporation the residue is heated to glowing until all the nitrous gases are evolved. The sulphur is then estimated as barium sulphate. The oils containing from 1–10% of sulphur compounds react with alcoholic mercury chloride solution to form addition compounds. The extraction of the sulphur compounds with mercury and mercury compounds amounts to 50% as against 30% using pure adsorbents. The value of the insulation resistance is found to increase in the treated oil. Some higher mercaptans, disulphides and sulphides affect the electrical constants and act as protective substances in the oxidation of the oil. The formation of wax is considered critically, and analyses of the refined wax products indicate that an enrichment of sulphur takes place in these products. The sulphur compounds also have an extensive effect on polymerisation and condensation products, and the removal of the active sulphur prevents the formation of these products to a certain extent. W. S. E. C.

254. Breakdown of Bituminous Road Emulsions. K. Kell. *Bitumen*, 1933, **3**, 11–17.—A further investigation of the method of determining "Breakdown Value" of bituminous emulsions devised by Weber and Bechler (see Abstract No. 722, 1932). Repeated results on the same stone and emulsion showed considerable divergence, so experiments were carried out using, instead of distilled water for washing, 0·25% KOH, 2% potash soap, and 2% soap with 0·25% KOH. It was concluded that 2% soap was the most satisfactory solution for washing the bitumen/stone. The differences in the results, however, were still large, and experiments with 4 stones showed similar irregularities, negative results being obtained in some cases. Apparently fragments of stone are split off in the washing. To obviate this, a modification is suggested in which the bitumen is extracted from the stone with benzene—particularly when the breakdown value is less than 2·0.

Comparative results are given for 9 emulsions and 4 stones for two observers.

No relation could be found between bitumen content, viscosity (°E at 20°C) or free alkali content and breakdown value. (The influence of the proportion of bitumen, free alkali and the temperature of manufacture on the viscosity of the emulsion is discussed briefly.) As the alkalinity increases the breakdown value reaches a minimum.

In the manufacture of emulsions, stability on storage is essential even at the expense of a lower breakdown value.

Variations in the details of manufacture are considered not to be responsible for differences observed on separate samples of the same emulsion, the latter being more often due to faulty sampling and to the despatch of the samples in tinned or galvanised containers which are attacked by the alkali,

the equilibrium of the emulsion being upset. Samples should be examined at the earliest possible moment.

The stability of samples prepared with KOH is greater than when NaOH is used.

The author shows by experimental results that soluble salts contained in the stone play an important part in breakdown (powdered stones were extracted with water and the filtered extract shaken up with emulsion in known proportions). Hard stones (*e.g.*, basalt, granite) show very little material soluble in water, but softer stones may show 0·1%; the former give low breakdown values.

The neutralisation of the chemically active water-soluble constituents of the stone by alkali (*e.g.*, magnesium and aluminium salts) must account for the retardation of the breakdown of an emulsion on raising its alkalinity.

On the road, the old surface is as important as the grit; it is possible that the suitability of the emulsions for use in wet weather may be due to dissolved salts already extracted from the surface which rapidly break the emulsion.

It is concluded that it is scarcely possible to evaluate a stone or an emulsion by this method, although useful knowledge is obtained by it.

In a footnote the editor discusses the effect of polyvalent metals and positive ions on the stability of emulsions. C. C.

255. Patents on Analysis and Testing. A. Hawkyard. E.P. 385,765, 5.1.33. —A pressure controlled mercury valve is described, its purpose being to protect the pressure gauge of gas analysis apparatus from cyclic pressure fluctuations except at the end of each suction stroke of the pump. W. H. T.

Class 600. Refining and Refineries.

256. Argentina and Italy Developing their Refining Facilities. *Oil and Gas J.*, 3.11.32, **32** (24), 12.— *Argentina.* The local production of gasoline in Argentine supplies 68% of the country's demand (5,311,000 brls.), and it is estimated that with adequate tariff protection the entire demands could be met, although this would necessitate the importation of crude oil. The largest refinery in Argentina is that of the Y.P.F. at La Plata with a capacity of 15,000 brls. daily, consisting of a distillation unit and Cross cracking plant, which operates on Comodoro Rivadavia and Plaza Huincul crudes. The Y.P.F. also operates small refining plants on the two fields. Other refineries are those of the Compania Nacional de Petroleo, Ltd., at Campana (capacity 10,000 brl./day), operating on Plaza Huincul and Salta crude, and also imported Peruvian crude, and at Bahia Blanca (capacity 2500 brl./day) operating on Plaza Huincul crude. The Diadema Argentina at Buenos Aires (6000 brl./day), operating on Comodoro Rivadavia crude, is also equipped with Dubbs cracking plant. The Compania Ferrocarrilera de Petroleo operates a 2500 brl. refinery at Comodoro Rivadavia, utilising their own production of crude oil. Plans for the modernisation and enlargement of the Itaca refinery at La Plata will increase its capacity from 1000 brl. to 4000 brl. daily.

Numerous other small refining units operate in Argentina, several of which are contemplating the installation of cracking equipment.

Statistics of the local production, imports and demand of the various products in 1931 are given.

Italy. In 1931 the Italian production of gasoline supplied 26·6% of the local demand, as compared with 3% in 1926. Cracking plants accounted for 75% of Italy's output for 1931 of 1,129,225 brl., an increase of nearly 6·0% on the 1930 figure, while the 1932 output is estimated at 1,530,000 brl.

The largest refinery is that of the Societa per la Industria del Petroleo at Spezia (Royal Dutch-Shell), which commenced operations in November, 1929, and is equipped with Dubbs cracking units running on Rumanian fuel oil. The Naples refinery of the S.A. Benzina Italiana (controlled largely by Petrofina) operates on Russian fuel, producing gasoline, Diesel oil and fuel oil.

An Italian company—Distillazione Italiana Combustibile S.A.—operates in Venice a Dubbs cracking plant of 800 brl./day capacity and is installing a second Dubbs unit.

The Azienda Generale Italiana Petrolio (A.G.I.P.) operates a plant at Fiume formerly belonging to the R.O.M.S.A., processing imported crude to lubricating oils and also operating cracking units.

White paraffin oil and heavy transformer oil are produced by the Raffinera Italiana Olie from Russian Solar oil.

The local Italian production from the Valezza and Salsomaggiore fields in the vicinity of Padua is worked up by three small topping plants in that area. The Italian oil industry will probably be affected by the Iraq production, as the A.G.I.P. own a 25% interest in the British Oil Development Co.'s concession on the western side of the Tigris. C. L. G.

257. Estimation of Tower Temperatures from Equilibrium Vapourisation Data. W. L. Nelson. *Nat. Petr. News*, 14.12.32, **24** (50), 25–34.—A discussion of the principles underlying the operation of fractionating towers. A method, based on the law of the conservation of energy and the law of partial pressures, is given whereby the plate temperature in the tower can be calculated. The calculation of the temperature at the top of the tower involves a determination of the lowest temperature at which the overhead vapour can remain as a complete vapour. The side-draw temperatures involves the determination of the highest temperature at which the side draw liquid product can be completely condensed in the presence of the lighter products. Tables are given in which a series of calculated temperatures are given against the temperatures actually determined. The tolerance appears to be about 7%. H. G.

258. Artificial Ageing of Mineral Oils. F. Evers and R. Schmidt. *Petr. Zeit.*, 25.1.33, **29** (4). I.P.K. Reprint, No. 18,691, 1–7.—The mineral oils were oxidised in a special apparatus using metallic oxides—*e.g.*, copper oxide impregnated with silica gel as catalyst. The oxygen consumed was measured by electrolysis, and the oxidation was accomplished in 100 minutes or less. The quantity of oxygen absorbed is dependent on the quantity of oil and catalyst used, activity of the catalyst, temperature and the nature of the oil and its reactivity towards oxygen. Various equations are derived showing the relationship between these factors and the velocity constant of the reaction. The evaluation of a series of oil analysis shows that a relationship exists between the actual duration of the ageing and the saponification value. Good oils showed an average yearly increase of 0·08 in the saponification figure, and those oils which had been aged exhibited a mean annual increase of ·10 or more for insulating oils. It was also observed that aged oils were more yellow in their luminescence when a quartz lamp was used as the source of light; oils which had been treated in the oxidation apparatus were dull in colour when viewed under the mercury lamp.
W. S. E. C.

259. Use of Inhibitors as Solution to Gum Problems. R. C. Conine. *Oil and Gas J.*, 24.11.32, **31** (27), 14.—The article is a summary of the more important research and development work which has been carried out by various

investigators on the related problems of: (*a*) the determination of "preformed" and "potential" gums in gasolines; (*b*) the constitution and probable method of formation of preformed gums; (*c*) the action of inhibitors and methods of evaluating their efficiency. Theories propounded by various authors are stated, and reference made to a number of gum inhibitors which have been found to be effective in use. R. A. E.

260. A Naturally Active Bleacher. E. Belani. *Petr. Zeit.*, 14.12.32, **28** (50), 11–12.—The use of carbonite, a new naturally active bleaching earth obtained from the volcanic hot springs in the region of Carlsbad, is described at length. It has a high content of silicic acid and aluminium compounds, and is basic in character on account of its calcium and magnesium oxide content. It is recommended to use for preliminary treatment followed by a high-grade activated earth. The earth has a high filtering capacity, and the speed of filtering is satisfactory. The filter-cloths are not attacked, and the filtrate remains odourless.

In refining lubricating oils the agitators must have flat cones, otherwise too much powder is held in the angle between the shell and the cone. From 3 to 4% of the powder is mixed with the cold oil until all traces of inorganic acids disappear, after which the oil is raised to filtering temperature as quickly as possible—*i.e.*, between 50 and 70° C. is the optimum for light oils, and from 70–90° C. for heavy oils. It is better to treat the oils with dilute acid, sulphuric acid of 88–90% concentration being recommended for Grozny lubricating oils. The oil can be bleached as well as refined by adding 0·5–1·0% of a highly active bleacher, but all the moisture must be removed from the earth first. If finely ground lime is used to neutralise the oils, say 0·25%, this should be mixed with the cold oil for about ½ hr. before adding 1·5% of carbonite and mixing for ½ hr. longer.

From 1–2% of sulphuric acid is used to refine paraffin. This is followed by 0·5% of carbonite mixed for ½ hr. with air until all the acid smell is removed. Finally, 1·5–2·0% of a highly active earth is added and mixed for 1 hr. at 120° C., after which the wax is filtered.

From 40–50% of a more expensive highly active bleaching earth can be replaced by carbonite. Moreover, the earth is not hygroscopic, and is improved by long storage, oil easily being removed from it. W. S. E. C.

261. Studies in Filtration. II. Fundamental Axiom of Constant-Pressure Filtration. B. F. Ruth, G. H. Montillon and R. E. Montonna. *Ind. Eng. Chem.*, 1933, **25**, 153.—The press used in this research offered a filtering area of 134·7 sq. in., and filtrations were carried out at constant pressures up to 60 lb. sq. in., using compressed air. The sludge was kept in suspension by a propeller running at 50 r.p.m., while the filtrate passed to a receiver, built so that one inch rise in level was equivalent to one litre of filtrate. Records of time and filtrate volume were made by the use of a rotating drum and a pen attached to a float.

For the study of non-compressible or rigid filtration Filter-Cel was used, and tests were carried out in series of four or five filtrations. It was found that the later tests of a series showed better agreement than did the early tests, and that the slopes of the V^2 vs θ (V=volume of filtrate, θ=time) plots were always less. The only factor which could not be controlled was the resistance of the cloth used as a filter septum, and evidence served to indicate that this resistance was subject to change, and apparently possessed a greater resistance to flow in the later tests. Extrapolation of the time-volume curves below the recorded base line to such points that the initial rates of filtrate flow were identical gave a value C below the base line. Then the entire course of filtration could be described by: $(V+C)^2=K\ (\theta+\theta_0)$

where θ_o = a corresponding shift in the time axis. C must be regarded as a measure of the resistance that existed previously to the instant filtrate appeared at the measuring device, and was equivalent to the resistance of a layer of solids which would be separated from C litres of filtrate in an imaginary filtration beginning with zero resistance to filtrate flow. Owing to the presence of the supporting septum, the resistance can never be zero, and the equation above satisfied this condition. The relation, however, implied that when $V=O$, $C^2=K\theta_o$—*i.e.*, that θ_o represented the time theoretically necessary to obtain C litres of filtrate, and experimentally this was not true, as it was not possible to get correspondence between zero time and zero filtrate volume. In filtrations, no filtrate appeared in the receiver until the drainage spaces and leads had been filled; the volume necessary for this was taken as C_L and the time as θ_L. Further, if C_b, an additional volume, represented the effective resistance of the filter septum and θ_b the time necessary to generate this resistance by a filtration, then the total displacements were :—

$$V: \quad C_b+C_L=C$$
$$O: \quad \theta_b+\theta_L=\theta_c$$

If the time record began when prefilt was admitted to the frame, θ_o was theoretically equal to θ_b; if it began when filtrate entered the recording device, $\theta_o=\theta_b+\theta_L$. The conclusion was drawn that the data of all the tests (on a time-volume basis) composed portions of a single and perfect parabola, in which the constant factors—pressure, filtering area, filtrate viscosity and sludge concentration—were represented by the constant K.

Data were collected from many sources for a number of materials of greater compressibility than Filter-Cel, and the agreement with the equation $(V+C)^2=K(\theta+\theta_o)$ was excellent. This led to the formulation of the following fundamental axiom of constant-pressure filtration: "The time-volume curve of a properly performed constant-pressure filtration forms a portion of a perfect parabola, of which the missing part near the vertex represents the theoretical course of a similar filtration, which would generate a resistance to filtrate flow equal to that already existing when measured filtrate volume is zero." The data of other workers were reviewed, and the necessary conditions for a properly performed filtration were enunciated.

A method for the determination of K and C and for the examination of the degree to which data are parabolic is outlined.

The authors concluded that Poiséuille's law was obeyed throughout the entire filtration period and that the relation between total resistance and filtrate volume was such that $\frac{R}{V+C}$ was a constant at all times during the filtration and for all types of materials. E. N. H.

282. New Methods of Dewaxing and Acid Refining Mineral Oils. N. O. Backlund. *J. Inst. Petr. Techn.*, 1933, **19**, 1–24.—A lecture with discussion on: (*a*) the dewaxing of mineral oils by a centrifugal method using trichlorethylene as the solvent, and (*b*) the acid treatment of mineral oils using centrifugal separators. The methods described were developed by the Separator-Nobel Company. G. R. N.

283. Treating Lubricating Oils with Sulphur Dioxide. O. P. Cottrell. *Oil and Gas J.*, 1.12.32, **31** (28), 10.—A brief description of the application of the Edeleanu process to lubricating oil manufacture is given. With the use of engines having higher compression ratios, bearing pressures and speeds, specifications for lubricating oils have been changed. Oils having a good oxidation test have been produced by the use of sulphur dioxide alone, but, in order to meet viscosity index requirements with oils from certain types of crude, it was necessary to increase the solvent power of sulphur dioxide. It

has been found that the addition of benzole is effective in this respect. The two solvents are miscible in all proportions, so that the percentages can be varied to suit the distillate under treatment and the result desired. The type of equipment used is generally the same as that of the ordinary Edeleanu plants, and the mixed solvents are stable and can be satisfactorily recovered. The results of tests carried out on a Pennsylvanian bottom cylinder stock, a Gulf Coast lubricating distillate and three Californian lubricating distillates, using (*a*) sulphur dioxide only, (*b*) mixtures of benzole and sulphur dioxide, are tabulated and the properties of the oils produced by the two processes are compared. Yields of raffinate are stated and are lower when using the mixed solvents. The ratio of total solvent to oil for each individual oil was similar for both processes. The results indicate: (1) the sp. gr., viscosity-gravity constant and carbon residue of Penna oils can be reduced, especially when using the mixed solvents, and the quantity of clay required for a desired final colour considerably reduced; (2) with Mid-Continent, Gulf Coast and Californian stocks the mixture of solvents gives better results than sulphur dioxide alone in regard to gravity, carbon residue, viscosity index, viscosity-gravity constant and Sligh oxidation test of the raffinates produced. Properties and yields of products obtained by redistillation after treatment of the stock by both methods are given in the case of the Gulf Coast distillate, and the results support the conclusions already mentioned. Since the total quantity of solvent used is the same for both processes, operating costs of the benzole/sulphur dioxide treatment are estimated to be the same as those for sulphur dioxide treatment.

Treatment of an oil in a 1000-barrel plant using 200 volume per cent. of 50/50 mixture of benzole and sulphur dioxide is estimated to cost 21·65 cents./barrel of distillate for operating materials and labour, power and maintenance.

R. A. E.

264. Effect of Paraflow on Wax Crystal Structure. G. H. B. Davis. *Nat. Petr. News*, 28.12.32, **24** (52), 32–34.—It has long been known that many substances, such as asphalt, reduce the pour point of the lubricating oil to which they are added. Many attendant disadvantages, however, preclude their use for that purpose, and "Paraflow," a synthetic product, has been developed for this purpose. A brief outline of the manufacture of "Paraflow" and a table showing the properties of a typical specimen are given. The comparison of a dewaxed oil and a waxy distillate indicates that the wax functions in raising the pour point by forming a more or less complete skeleton of crystals in which the oil is held chiefly mechanically, but partly by actual adsorption in the crystals. Photomicrographs show that after the addition of "Paraflow" the size of the crystals has been greatly reduced, and that to a certain extent the physical form of the wax has been changed from needle crystals to small equi-axial grains. However, since substances such as ceresin also decrease crystal size without lowering the pour point, it would appear that "Paraflow" functions also by inhibiting adsorption of oil by the wax.

H. G.

265. Modern Methods of Benzole Refining. Use of Inhibitors for Preventing Gum Formation. W. H. Hoffert and G. Claxton. *J.S.C.I.*, 1933, **52**, 25–33T. Formerly, the methods employed for refining benzole to make it gum-stable involved treatment with concentrated sulphuric acid. Losses of 5–10% of the crude benzole resulted from this treatment owing to removal of unsaturated and aromatic hydrocarbons. The unsaturateds have a definite fuel value, and the introduction of an oxidation test as an alternative in the new specification for Motor benzole of the National Benzole Association renders these heavy losses no longer necessary. Methods employing more dilute

sulphuric acid and hot 60% caustic soda, or treatment with a mixture of absorbent clay and ferric sulphate, are now in use. Another method of rendering benzoles free from tendency to form gum in storage is by adding small quantities of substances known as "inhibitors."

The most effective inhibitors of gumming have been found to be the phenols and aminophenols. The property appears to be possessed by substances that are themselves readily oxidised. Substances which promote gumming of unsaturateds are usually acidic in character. The addition of an inhibitor gives rise to a delay or "induction period" before gum formation begins. This induction period can be measured by means of an oxidation test recently standardised (cf. Abs. 53). If a period of over three hours is obtained in this test, a benzole will be stable under normal storage conditions for at least six months. Benzoles from high-temperature carbonisation can usually be stabilised effectively by the addition of 0·03 to 0·05% weight of o- or p- cresol.

A number of curves are given showing the effect of the concentration of various inhibitors on the quantity of gum formed by a benzole after three hours' oxidation by the accelerated test method. The gum formation in general decreases very rapidly with the addition of the first traces of inhibitor until a minimum is reached, after which the gum formation slowly increases with increasing concentration of inhibitor. The optimum concentration of inhibitor varies with the nature both of the inhibitor and of the fuel—*e.g.*, it might be 0·001% weight of p-methyl aminophenol in a given benzole or 0·05% of o- or p-cresol in the same benzole (m-cresol is less effective than its isomers).

The choice of an inhibitor for a particular purpose depends on the colour stability and volatility of the inhibitor and also on its relative solubilities in benzole and water. Traces of acidic materials in the benzole tend to reduce the effectiveness of, or even to destroy, an inhibitor. Technically pure cresylic acid (60% o- and p-cresols) is one of the most suitable inhibitors.

Sulphur compounds such as sulphur dioxide and thiophenol are objectionable as they often tend either to accelerate gum formation or to reduce the effectiveness of the inhibitor. Some benzoles can be stabilised by adding inhibitor immediately after fractionation. Generally, however, a caustic soda wash is necessary to remove phenols already present in the benzole—particularly higher phenols which tend to cause discoloration. Pyridine bases are best removed by washing with dilute (25–40%) sulphuric acid. Examples of typical treatments are given. After six months' or a year's storage benzoles so treated generally show less than 5 mg. gum per 100 ml. on the oxidation test.

Some benzoles require further treatment for the removal of sulphur, colour and odour, and the restricted use of sulphuric acid is recommended for this purpose. Much of the sulphur is contained in the low-boiling fractions (as carbon disulphide), and is best removed by treating this fraction separately by re-fractionation. Thiophene derivatives in the middle fraction may be partially removed by treatment with sulphuric acid. Colour and odour are removed by acid washing of the highest fraction—above about 110° C. Judicious treatment of the fractions in this way and subsequent addition of an inhibitor gives products free from objectionable colour, odour, and gumming tendency, and with reduced sulphur contents. The refining losses are also much reduced. Particular methods must be selected with reference to the benzole to be refined and the specification to be met. E. B. E.

266. By-Products Obtained in Manufacturing Volatile Gasolines. C. K. Francis. *Oil and Gas. J.*, 19.1.33, **31** (35), 18.—It is estimated that in 1932 the sales of liquefied petroleum gases amounted to 32 mil. gals., of which

17 mil. gals. were distributed as bottled gas, 7 mil. gals. used in gas manufacture and 8 mil. gals. used for industrial and miscellaneous purposes. The rapid growth of the market is illustrated by statistics. Propane is mainly used in the bottled gas industry as it may be released at temperatures down to −44° F. Analyses of commercial propane prepared from natural gas and from refinery gas are quoted. For gas enriching and for supplying gas to small town systems, butane is mainly used on account of its high thermal value. The method of application is outlined. Numerous other industrial applications of commercial propane, butane and pentane are listed.

Other products now obtained from natural and refinery gases are n-pentane, n-hexane, n-heptane, mixed heptanes and mixed octanes. Each of these liquids consists mainly of the hydrocarbon mentioned. Boiling ranges, gravities and vapour pressures of these commercial products are indicated. They are excellent solvents for gums, waxes, rubber, etc., and are used as nitro-cellulose lacquer thinners. The extensive possibilities of obtaining other substances from petroleum gases by heat treatment and chemical action are indicated by reference to the report of the U.S. Bureau of Mines on this subject. R. A. E.

267. Safe Operation of Pressure Stills. W. B. Murphy. *Oil and Gas J.*, 29.12.32, **31** (32), 11.—The organisation of an Eastern (U.S.A.) refinery to safeguard pressure still operations is discussed in detail. Committees composed of the technical staff have been formed, each controlling different sections of the safety requirements, and thus ensuring the control by specialists of any particular safety work. The functions of each committee are outlined and reference made to the A.P.I. draft on safety precautions in cracking operations, which only covers very general instructions. It is emphasised that owing to the wide difference in type and operation conditions of pressure stills there are many other important safety operations which are not covered by these general precautions. C. L. G.

268. Estimating Refinery Construction Costs. G. W. Heinecke. *Petr. Eng.*, Dec., 1932, **4** (3), 21.—In a previous article (see Abstr. 1049/1932) the various items which should be taken into account when preparing estimates for the cost of plant construction were enumerated. Each of these items will be discussed in more detail in the present series of articles. The present article discusses the costs in connection with the plant site, including clearing and grading, surveying, building roadways, maintenance of plant site during building operations, final clean up of plant site and removal of trash and excess dirt. C. L. G.

269. Hot Oil Pumping Problems. G. Vandenberg. *Refiner*, 1932, **11**, 593–596.—The maximum lift of a hot oil piston type pump is the atmospheric pressure minus the vapour pressure of the liquid to be lifted. Pumping hot oil, either from vacuum or pressure operated vessels is analagous to the extraction of hot condensate from steam condensers, as the liquid to be pumped is usually at a temperature approximating to its boiling point. Therefore pressure on the suction side of the pump should never be lower than the pressure in the vessel from which the oil is drawn to the pump, otherwise the pump will become gas-bound. This danger may be guarded against by providing a static pressure on the intake side of the pump or by the provision of a booster in this line. A third means of preventing gas binding is by cooling the pump cylinders or plungers.

High pressure, multi-stage centrifugal pumps do not require booster or cooling equipment and this type of pump has been applied to hot oil pumping. They are built of high class steel, heat treated and quenched to prevent

distortions when operating under high temperatures. Stuffing boxes of rotating pumps cause more trouble than those of reciprocating pumps and a type of two-stage centrifugal pump adapted for vacuum pump-out work is constructed so that there is no stuffing box on the vacuum side of the pump. B. C. A.

270. Gravity Losses when Handling Hot Crude Oil. W. Woelflin. *Petr. Eng.*, Jan., 1933, **4** (4), 37.—An examination has been made of the gravity loss experienced by crude in passing from the electrical dehydrator to the stock tank, depending on whether the oil passes through a heat exchanger, cooling tower, or passes into the bottom or through the open manhole into the stock tank.

It was found that when dehydrated Signal Hill crude is passed into the stock tank through an open ell at the manhole at the top of the tank at a temperature of 140/150° there is a gravity loss of 1·0° to 2·0° A.P.I., depending on the gravity temperature and initial boiling point of the oil. For the same oil entering the bottom of the tank, the gravity loss will probably not be over 0·5° A.P.I. if the oil temperature is not over 130° F. It is suggested that oils lighter than 20° A.P.I. should enter the stock tank at the bottom. Heat exchangers or cooling towers should be used to reduce the temperature to 140° F. or below. With vapour tight tanks, the gravity loss can be reduced to 0·1/0·3° A.P.I.

The volume losses occurring under the above conditions will be discussed in a later article. C. L. G.

271. Patents on Cracking.—W. W. Triggs. E.P. 385,610, 22.12.32. Method of coking heavy petroleum residues and of cracking the resultant petroleum vapours. W. H. T.

272. Patents on Hydrogenation.—I. G. Farbenind. E.P. 385,433, 29.12.32. Undesirable carbon deposits formed by the polymerisation products of unsaturated hydrocarbons are obviated by preheating the initial material under conditions such that these products are formed and carried forward by the oil stream and deposited in a separator, from which they can be recovered and passed on for further treatment. The depolymerised oil is vaporised in the separator by means of preheated hydrogen, and the mixture passed on to the reaction vessels.

I. G. Farbenind. E.P. 385,774, 5.1.33. Fatty and certain vegetable oils are deodorised and rendered edible by treatment with hydrogen at a temperature below 100° C., the quantity of hydrogen taken up being limited to a value which ensures no change in the physical (viscosity) property of the product.

A. G. Krupp. E.P. 385,781, 5.1.33. Refers to the construction of reaction vessels for use in carrying out chemical processes operating under conditions of high temperatures and pressures. The vessel is made up of two or more nested, hollow cylinders interconnected by shrinking. The inner cylinder is made of chrome steel specially resistant to chemical attack, the outer cylinder is made from an alloy steel which maintains its strength at high temperatures. The exterior of this cylinder is covered with heat-insulating material. Detailed composition of the alloys used in the construction of the cylinders is given. S. B.

273. Patents on Motor Fuel.—Standard Oil Devel. Co. E.P. 385,066, 22.12.32. Gum formation in low-boiling fractions free from iron carbonyl is retarded by the addition of a small amount of a coloured inhibiting compound which bears no sulphonic acid or thiobenzyl group. The compound may belong to one of the following classes: Indophenols, oxazine bases, indamine bases,

eurhodine bases, safranine and aposafranine bases, and amino azo bases, other than spirit yellow R.

Metallgesellschaft A.-G. E.P. 385,257, 22.12.32. Recovery of hydrocarbons from gases containing diolefines which exert an injurious influence on adsorptive media. The proportion of adsorbent to recoverable material is kept low (less than 2 : 1), the gas velocity is kept high (above 20 cm. per sec.), the layers of adsorbent are less than 1 metre in depth, and short regenerative periods are employed.

Standard Oil Dev. Co. E.P. 386,075, 12.1.33. Debutanisation of naphtha, in which a light and a heavy fraction are withdrawn from the fractionating zone. The latter fraction is stripped of light ends, which are returned, together with the light fraction, to a second fractionating zone for the production of a stabilised light naphtha. W. H. T.

274. Patents on Special Products.—E. V. Hayes-Gratze. E.P. 384,996, 9.12.32. An insecticide comprising a neutral sulphonated and electrically ionised oil in combination with water. Small amounts of carbon-tetrachloride, soap, sodium hypochloride, caustic alkali or camphor may also be added.

H. Eisner. E.P. 385,306, 19.12.32. The viscosity of greasy oils (*e.g.*, liquid paraffin) used for cosmetic purposes may be reduced by the addition of 3–10% of essential oil. The mixture is subsequently exposed to the action of ultra-violet rays. W. H. T.

275. Patents on Refinery Plant.—Metallgesellschaft A.-G. E.P. 385,866, 5.1.33. Apparatus for vacuum distillation of heavy mineral oils, condensible substances being injected into the charge for the reduction of the partial pressure of the distillate vapour. These substances are condensible by cooling with water or air under a high vacuum, and are injected into the charge in such a manner as to induce a circulation of the liquid in the still.

H. Svenson. E.P. 385,914, 5.1.33. Means for lighting a liquid fuel burner. A bowl is situated below the burner, fed with inflammable liquid which can easily be ignited.

Sharples Speciality Co. E.P. 386,382, 19.1.33. Fractional vacuum distillation of heavy oil. Reflux liquid is fed to the top of the column and additional heat is introduced into the column by contacting the oil with a heated fluid. This is of higher molecular weight than water and of lower susceptibility to thermal decomposition than the highest boiling fraction. W. H. T.

Class 700. Utilisation.

276. Increasing Utilisation of Fuel Oil Fractions. R. P. Russell and W. V. Hanks. *Oil and Gas J.*, 1.12.32, **31** (28), 14.—Although the production of fuel oil in the U.S.A. has been reduced by the expansion of cracking operations and the use of lighter crudes, there are still large stocks of fuel in hand. The following methods of increasing consumption or decreasing production of fuel oil have been proposed :—(*a*) Development of new outlets for fuel oil; (*b*) conversion of fuel oil to other products; (*c*) modification of refinery operations to produce less fuel.

(*a*) The offtake for fuel oil may be increased by :—(1) The substitution of fuel oil for coal in large power plants; (2) substitution for gas oil in car-

buretted water gas plants; (3) use for surfacing secondary roads; (4) stimulation of domestic fuel consumption.

1. Calculations are given to show that the cost of conversion from coal firing to oil can only be warranted if the price of fuel oil is maintained below 80 cents/brl. for at least three years. 2. Heavy fuels are generally found unsuitable for gas enriching, although one company is using 16/18° Be. fuel with Conradson of 10%. It is usually more economical to crack it than to sell it to gas companies, since heavy fuel must be very cheap to outweigh its low carburetion value. 3. The conversion of dirt roads to first class highways by yearly application of petroleum residues offers a very useful offtake for heavy fuel. It is estimated that the total yearly cost of such a road is less than a third of that of a normal hard surfaced highway. 4. If the cost of domestic fuel burner systems were reduced—comparable with that of an electric refrigerator—a potential market of 27/30 million brls. per year could be attacked. Cheapening of the installation and adaptation of the burner to use heavier distillates would allow the refiner to cut deeper into the crude and produce less fuel, or, alternatively, stimulate the conversion of heavy fuels to more suitable burner fuels.

(*b*) Suggested methods for converting fuel oils into other products are :—(1) Complete gasification; (2) hydrogenation to gasoline; (3) topping to give cracking stock and heavy tar bottoms.

1. Complete gasification can be effected by the usual water-gas process. In one case a 5° Be. gravity fuel was gasified, yielding a gas with the composition : H_2 72%, CO 14%, CO_2 9%, CH_4 1% and N_2 4%. 60% of the available B.Th.U's being recovered in the gas. The cost of equipment and operation is similar to that of the normal water-gas plant, so that in places where fuel is cheap and coal dear, a large potential market exists. 2. Hydrogenation of fuel to 100% gasoline is technically possible, but the cost is prohibitive under present market conditions. 3. Topping of heavy fuel to give a more valuable distillate and a thick residue is profitable where a market exists for the residue. This can be burnt by increasing the size of the combustion chamber and by increasing the preheating temperature, actually having a higher heating value than the normal heavy fuel. The overhead can be used for carburetion of water gas, cracking to gasoline, use in low speed Diesel engines and possibly in domestic oil burners.

(*c*) Modification of refinery operation to yield less fuel oil per volume of gasoline may be carried out by :—(1) Cracking to heavier residues; (2) partial replacement of cracking units with hydrogenation—which gives no fuel oil; (3) cracking to higher ultimate yields of gasoline of poor anti-knock value, the octane number being maintained by the addition of lead.

1. Cracking to heavier residues is profitable where a market (*e.g.*, as road oil) exists for these residues. 2. Comparative yields of products from hydrogenation and cracking of a gas oil are given, the former giving 85% of gasoline of octane number 82·5 and no fuel oil, and the latter 51·5% of gasoline of octane number 76·5, and 39·5% fuel oil. Hydrogenation is attractive where refractory cracking stocks are concerned, but profitability depends entirely on local operating cost, type of oil handled and the final structure for the different products. 3. Increasing the yield of cracked gasoline of lower octane value was found in one case to reduce the crude oil run by 6% and the fuel oil and gas production by 20%. The cost of the additional lead was more than offset by the saving in cracking operations.

In conclusion, the most likely methods of disposal of excess fuel oil seem to be :—use for secondary road construction and—depending on local

conditions—use of heavier fuels by large power users and cracking to give higher yields of gasoline of lower octane number. C. L. G.

277. Erren Hydrogen Engine. Anon. *Mar. Eng.*, 1933, **56**, 15.—A short description of an engine which works on an oxygen-hydrogen mixture. The engine has a bore and stroke 230—300 mm. and develops 300 h.p. at 500 r.p.m.

Hydrogen is stored at 3000 lb./sq. in. pressure, and is admitted to the cylinder at much lower pressure by means of a special double inlet valve, which also admits the oxygen, but ensures that no mixing takes place, except in the actual combustion space, thus obviating explosion risks. The engine exhaust can be used for heating in the form of water. Ignition is by ordinary sparking plug. Attention is drawn to the possibilities of the engine for submarine craft. On the surface the engine would run on a mixture of oil and hydrogen for charging the gas containers from electrolytic plant, and under water on the oxy-hydrogen mixture. C. H. S.

278. Engine Design and Volatility of Gasolines. G. G. Brown. *Oil and Gas J.*, 19.1.33, **31** (35), 13.—Using an engine in good condition with a choke able to reduce the air-fuel ratio to about 1 to 1, and with oil and battery conditions such that the engine may be cranked at a speed of not less than 30 r.p.m., it has been found that with varying percentages of the fuel vaporised the number of revolutions required for starting are :—(1) 5%—starting practically impossible ; (2) 6·5%—20 revs. ; (3) 7·5%—13 revs. ; (4) 10%—7 revs. ; (5) 25%—3 revs. Satisfactory starting demands that 8/10% of fuel be vaporised, but easy starting requires 25%. To obtain a fairly satisfactory indication of the lowest temperature at which a fuel will give :—(*a*) Satisfactory starting, subtract 125° F. from the 10% A.S.T.M. distillation temperature ; (*b*) easy starting, subtract 130° F.

In order to improve starting and acceleration and also to take advantage of the improvement in volatility of fuels which has occurred during the last three years, most modern cars are equipped with :—(*a*) a loaded valve in the choke which opens immediately the engine begins to gain speed, and thus prevents excess choking ; (*b*) carburettors which inject an additional charge of fuel into the manifold whenever the throttle is suddenly opened, thus compensating for the delayed distribution of unvaporised liquid fuel along the walls of the manifold ; (*c*) thermostatically controlled radiation shutters or a device enabling the cooling water to bye-pass the radiator until a desired temperature is reached ; (*d*) means for heating the intake manifold with exhaust gases until a predetermined temperature is reached when a valve cuts off the exhaust heat, since, with the reduction in the 90% distillation temperature of gasolines, it is necessary to limit the heat supplied to the intake in order to avoid loss of power when the motor is thoroughly warmed. Other refinements of these major changes are detailed. The influence of fuel volatility on the period required for warming up the engine, and on fuel distribution in multi-cylinder engines is discussed. Car manufacturers appear to have taken into account the changes which have taken place in the volatility of fuels in designing new models. Steps which have been taken to reduce the danger of vapour-lock are also outlined. The opinion is expressed that vapour pressure limits could be even further increased if greater attention were paid to location of fuel lines. R. A. E.

279. Rating of Diesel and Other Engines. W. A. Tookey. *Diesel Engine Users Assoc.*, 16.11.32.—The early formulæ for calculating the b.h.p. of an engine, based on the cylinder dimensions, are given, and it is shown that,

even at the time when these formulæ were put forward, they were of little value. This contention is supported by tables of the rated horse power, cylinder dimensions and speed of revolution, of steam, gas and oil engines of about the year 1895. As a comparison, similar tables are given for modern engines.

The British Standard Specification for the rating of diesel engines, dated 1925, is as follows:—

"The rated output of the engine shall be the load in b.h.p. which it is capable of carrying continuously for a period of 12 hrs. at its rated speed when working under the following conditions: Barometric pressure, 30 in. of mercury; atmospheric temperature, 62° F. (16·7° C.).

"For continuous day and night running the maximum load on the engine shall be 10% less than the rated output."

An attempt to obtain an agreement on B.M.E.P. as a basis of rating was unsuccessful.

There must of necessity be a margin of capacity for satisfactory operation, and the specification continues: "The engine shall be capable, for periods of one hour., of developing a load of 10% above its rated output without undue heating of the engine or other mechanical trouble."

It was the implied intention of the definition that the rated output of the engine should be available after all power absorbed by the accessories had been allowed for as if driven by the engine itself: that is to say, that any lubricating oil pump, water pump, air compressor for fuel injection, for scavenging or for supercharging, should be taken into account when computing the b.h.p. output.

Attention has been drawn to the fact that if an engine will run for 12 hrs. to comply with the specification it would run for much longer periods at the same output. This is perfectly true; but the 10% allowance for day and night running has been stipulated for the reason that, when an engine is continuously in operation, there must be a margin to allow for imperfect tuning, since many adjustments are impossible while the engine is running.

To avoid disappointment, therefore, a purchaser must realise that adequate margin should be allowed between the rated output and the normal engine load, according to the class of machinery the engine has to drive.

The use of the kilowatt as the unit of power output is discussed. Whilst this is a more scientific unit, it suffers the disadvantage that ordinary individuals might be confused by the term, since a 100-k.w. engine would be inadequate to drive a 100-k.w. generator.

The temperature and pressure values given in the specification have since been modified to 20° C. or 68° F. and 760 mm. or 29·92 in. of mercury-barometric pressure. This change is of no practical importance and is within the daily limits of variation.

The 1925 B.S.I. allowance for pressure and temperature variation is set out as follows:

"When an engine is required to work under atmospheric conditions which depart from standard, the rated output of the engine will be modified as follows:

"For increase or decrease in the atmospheric pressure, a respective addition to or deduction from the rated output of the engine shall be made at the rate of 4% per in. of mercury. For any increase or decrease of temperature of the air at the intake a respective deduction or addition shall be made at the rate of 2% per 10° F. (5·6° C.)."

At the time it was decided that, as the barometer reading was a fundamental measurement of pressure, the allowance for altitude should be set out in terms of inches of mercury. The fact that altitude is constant while the barometric pressure at any time or place is inconstant would seem to warrant allowances being preferably based on height above mean sea level.

Tables are given showing the variation of barometric pressure and temperature with altitude and also the effect of these variables on the I.H.P.

The governing characteristics set down in the B.S.I. specification are discussed, and it is suggested that for some classes of work, greater variations should be permitted with advantage.

To allow for inaccuracies in the measuring apparatus, a tolerance of $2\frac{1}{2}\%$ is allowed on the rated output and fuel consumption. The author discusses the usefulness of the inclusion of tolerances in specifications.

In connection with lubricating oil consumption the author proposes that figures should be given on a basis of grams or lb. per. k.w. of rated output.

The last part of the paper deals with the basis of rating.

Primarily the maximum output of any engine depends upon the amount of oxygen in the cylinder at the moment of ignition: in other words, it is the performance of an engine as an air pump which has a direct effect upon its limitations. A curve showing the relation between percentage of oxygen in the exhaust gases and the number of B.Th.U. contained in 1 cu. ft. of total cylinder volume is given. This curve was obtained from results on a number of different engines, and it would appear that the maximum rated output of a heavy oil engine coincides with an oxygen content in the exhaust of 11%. A second curve is given correlating oxygen content in the exhaust and exhaust temperature. It is shown that 11% oxygen in the exhaust corresponds to 800° F. (thermometric). If combustion is continued beyond this limit, little is gained and the combustion becomes imperfect and the exhaust smoky. Two further charts are given connecting mixture strength and exhaust temperature and indicated mean effective pressure. From this series of curves, a mixture strength of 40 B.Th.U. per cu. ft. total cylinder volume corresponds to 10 lb/sq. in. indicated mean pressure with 800° F. exhaust temperature and 11% oxygen in the exhaust gases.

I.M.E.P. and B.M.E.P. are compared, and the practice of rating normally charged 4-stroke cycle engines on a basis of 70-72 lb./sq. in. B.M.E.P. is considered justified. Only a few engines can greatly exceed this figure, and ratings based on heavier fuel charges should be held suspect until proved to be entirely satisfactory. J. G. W.

280. Recent Developments in Diesel Engine Construction. R. Sulzer. *Mar. Eng.*, 1933, **56**, 5-8.—The increasing speed of the motorship is demanding corresponding greater output of propulsive power. Bearing in mind the desirability of obtaining as great a space as possible for freight and passengers, the engine builder is set the problem of designing reliable machinery demanding less space per unit of output. The paper deals with the pros and cons of single and double acting two- and four-stroke types for different classes of vessels. Details with illustrations and drawings are given of the power plant of the cross-channel motorship "Prince Baudouin," being an example of the latest modern construction. A further description is given of an experimental 6400 h.p. double acting two-cycle engine weighing only 22 lb./b.h.p., which has been achieved largely by adopting welded construction. A new patented system of improved scavenging and super-

charging is described, which it is claimed is much simpler than any method at present in use, and at the same time shows equal economic efficiency.

C. H. S.

281. Methyl Alcohol as a Component of Fuels. A. W. Schmidt. *Erdöl und Teer*, 1933, **9**, 74-77.—The introduction into Germany of a new composite fuel has recently been proposed. This is composed of 70% gasoline, 10% benzole, 10% ethyl alcohol and 10% methyl alcohol. The methanol is a synthetic product of carbon monoxide and hydrogen and has the advantage over ethyl alcohol that it can be prepared in a very dry state by simple distillation. The present paper describes experiments on the miscibility relationships and engine performance of fuel containing methanol.

Methanol will not mix appreciably with straight-run gasoline, but it is miscible to some extent with heavily cracked gasoline and spirit from brown coal on account of their high content of unsaturated compounds. The addition of ethyl alcohol will bring about miscibility of methanol and straight-run gasoline. These mixtures of gasoline with 10% methanol and 10% ethyl alcohol are stable. 10% of benzole will not bring about miscibility of 10% methanol with gasoline. In the case of some gasolines, 10% of ethyl alcohol will stabilise up to 20% methanol.

The octane numbers of various alcohol mixtures were measured on the Horning engine, using the D.V.M. procedure. From the results it is concluded that ethyl alcohol is more effective in raising the knock-rating of gasolines than is benzole; the anti-knock value of methanol is practically the same as that of ethyl alcohol: the knock-rating of benzole alcohol mixtures is intermediate to those of corresponding alcohol or benzole mixtures. Thus 20% additions of ethyl alcohol methanol and benzole raised the octane number of a cracked benzine, originally 59 octane number, 16, 16 and 12 octane numbers, respectively.

The performance of the fuels was investigated, using two engines of compression ratios 5 : 1 and 6 : 1 respectively. In the lower compression engine the horse power produced by the composite fuel (70% gasoline, 10% methanol, 10% ethyl alcohol, 10% benzole) was lower than that of a commercial fuel at the same r.p.m. The consumption with regard to horse-power was higher. In the higher compression engine, the differences are not so marked. The consumption of the methanol blend is higher at 1000 r.p.m. and lower at 1200 r.p.m. than that of either a commercial fuel or a gasoline-ethyl alcohol mixture. (Consumption expressed in gr. per horse-power hour.) It is concluded that the use of methanol blends is advantageous only in high-compression engines. E. B. E.

282. Premixed Macadam for Road Maintenance in Australia. S. M. Brown. *Roads and Road Constr.*, 1932, **10**, 364-365.—Many of the main roads were reconstructed with non-rigid bituminous pavements, and after a period of about seven years, during which they were all carefully maintained, they exhibited seriously uneven surfaces. When the even contour of a non-rigid tar or bituminous pavement has definitely been lost, complete disintegration is only a matter of time. The preservation of these roads has therefore become a major problem during the last three years.

The first method of dealing with these roads was to shave off the tops of all irregularities with a disc scarifier and to sweep off the cuttings. The road was then sprayed and covered with fine aggregate. Later a heavy drag was built for levelling the surface, and this is described. Results obtained with these machines were good, but the depth of cutting practicable was limited, and because of this the sprayed material gravitated into the depressions.

Irregularities not eliminated by planing were therefore filled by hand with hot premixed macadam. Patching was next discarded in favour of a thin continuous carpet of premixed macadam. Continuous carpets, using both hot and cold premixed materials, have been in service up to three years, and have in general been satisfactory. The new surface has bonded satisfactorily to the old, with either tar or bitumen, without a preliminary tack coat. Further developments were directed towards reducing the cost and to obtaining a more even contour by laying the carpet in two coats. This was not possible by hand methods, and mechanical means were therefore developed. A description of the apparatus, method of employment and number of men required is discussed.

A mixture of 40% of gas-tar pitch of 60 penetration and 60% of 100 penetration bitumen was used as binder. The physical properties of this material are given, and also details of the surface layer now used.

The advantages of using cold mixed materials are mentioned, the binders used in the cold process being a tar-bitumen mixture and 85/80 liquid bitumen. The composition of the tar-bitumen mixture is given.

Details of the road surfaces treated and tests obtained with a roughometer are described. A. O.

283. Preparation of Rough Road-Coatings Using Asphalt Bitumen. Anon. *Bitumen*, 1933, **3**, 22-23.—The roughness of a road surface depends on the composition of the coating and the nature of the stone chips used. An excess of binder should not be present.

For roughening new surfaces, soft bitumens (16–30° K. and S.) are suitable, since the chips can penetrate deeply. The kind and size of stone are important. For the hot process 12/18 mm. stone is first used, followed by a smaller size (<6 mm.). With emulsions, the finer grades are used—first 3/5 mm. and then 5/15 mm. (in two coat work). A treatment with bitumen coated chips on a surface previously treated with soft bitumen or emulsion is satisfactory.

Rolled asphalt coatings of correct composition give a permanently rough surface unaffected by wet weather. With floated asphalt, larger amounts of hard stone chips are necessary and a toothed roller is used.

Old surfaces which are slippery owing to insufficient stone chips can be softened with an oil (*e.g.*, gas oil, kerosine, tar oil—about 0·2–0·3 kg./m²), after which more chips (clean or bitumen coated) are scattered on the surface. Tar and tar-bitumen mixtures are useful on compressed asphalt surfaces, while asphalt bitumen, emulsion and cut-back bitumen are satisfactory for surface treatment where traffic is light. For heavy traffic rolled or floated asphalt surfaces are used. (It is desirable to warm the upper layer of the compressed asphalt by suitable means.) C. C.

284. Lubricated Gasoline. R. C. Conine. *Oil and Gas J.*, 29.12.32, **31** (32), 9.—Opinions on the value of adding small percentages of light lubricating oils to gasoline for top cylinder lubrication are divided. The results of certain laboratory tests carried out on gasolines with and without addition of such oils are reported. The effects of addition of 1, 3 and 5% of light lubricating oil on the octane rating and distillation characteristics of a gasoline are shown and indicate a slight reduction in octane number, and an appreciable increase in E.P. Tests carried out on a standard Ford model A.A. engine on dynamometer showed a reduction in maximum b.h.p. and increased fuel consumption per b.h.p. hr. at 1500 r.p.m. and at maximum b.h.p., when percentages

of lubricating oil or liquid paraffin varying from 3·9 to 12% were added to the gasoline. Further investigations, including tests to determine the sealing value of lubricating oil in the motor fuel, were carried out in a 4-cyl. engine. The mechanical clearances of pistons and ring grooves are tabulated together with the results of the tests. The percentages of oil added ranged from 0 to 12%, the duration of each test was 10 min., and determinations were made in the case of each sample at approx. 750 and 2300 r.p.m. The conclusions drawn from the test results were: (1) In the engine used no appreciable reduction in cylinder blow-by is obtained by adding lubricating oil to motor fuels in any permissible quantity; (2) no perceptible improvement in engine performance or fuel consumption resulted from the addition of oil; (3) the lubricants apparently passed through the combustion chamber without burning.

Lack of supply of new engines made it possible to ascertain the value of top cylinder lubricating oils during the running in period, but it is felt that such addition to the gasoline for the first 1000 miles is warranted as a precautionary measure. R. A. E.

285. Oil Reclamation Economics. G. T. Hook. *J.S.A.E.*, 1933, **32**, 20.—The author reviews available information, chiefly in the form of reports from operators of large fleets of 'buses and haulage trucks, and decides that "the effect of reclaimed oil on the engine is at least as good as, and not any worse than, that of the original oil." This conclusion is supported by reports from oil refiners, the Bureau of Standards and research laboratories. Examples of operators using reclaimers are cited which indicate that an overall cost of reclamation, including overhead, is about 12 cents. per gallon, varying according to variable conditions from 10 to 18 cents. This figure offers a substantial saving as opposed to the cost of new oil. Some operators of reclaimers claim that maintenance costs have also been reduced.

As regards the minimum quantity of crankcase drainings which it is economical to reclaim, this is obviously dependent on many factors—*e.g.*, cost of reclaimer, price of new oil, etc.—but one company is quoted which saved 571 dollars in five months, using equipment costing slightly over 800 dollars. In this time 1200 gallons of oil were reclaimed. W. E. J. B.

286. Reclaimed Lubricating Oils. A. E. Mockler. *Oil and Gas J.*, 15.12.32, **31** (30), 28.—At the 53rd Annual Meeting of the A.S.M.E., W. F. Parish and L. Cammen presented a report on "The Chemical Mechanism of Lubrication," containing data on reclaimed crankcase lubricating oils. The report stated that 10-year tests made with the refined reclaimed oil tended to show that such oils gave increased mileage and engine speed and reduced crankcase temperatures. The view was expressed that the operation of the engine separates from the new oil the sludge and waxes, which fill up the cavities in metal surfaces of shaft and bearing and so prevent free absorption of oil into the metal, or the forming of a film on the surface of the metal. The report adds that when oil is drained, filtered and cleaned, and then put back in the engine, it flushes out the deposits of sludge in the metal and does not permit them to build up again. Results of tests carried out to show the improvement in speed obtained when using reclaimed as compared with new oil were quoted. These claims were refuted by other speakers on the following grounds: (*a*) the increase in h.p. represented by the increased speeds reported were said to be greater than could be attained by entire elimination of engine friction; (*b*) exception was taken to the implied view that only a small percentage of the oil was subject to oxidation; (*c*) test results in a single cylinder test engine reported by another speaker showed practically

no difference in fuel or lubricating oil consumption, whether new or reclaimed oil was used, but the reclaimed oil gave greater carbon deposits. R. A. E.

287. Petroleum Specialities: Insecticides. A. J. Caplan. *Petr. Eng.* December, 1932, **4** (3), 51.—Formulæ are given for the preparation of fly sprays, liquid bedbug and roach insecticides, moth sprays and cattle sprays.

Petroleum distillates and refined oils are the most satisfactory base materials used in sprays and dips. The most effective toxic agent for fly spray and cattle spray is pyrethrum which is obtained in the form of a concentrated extract. Cresylic acid has been found the most effective poison for bedbugs and roaches, while paradichlorbenzene is of great value for incorporation into moth sprays.

The importance of the complete evaporation of household insecticide, without leaving stains or obnoxious odours is emphasised. C. L. G.

See also Abstracts Nos. 254 and 265.

ABSTRACTS.

Class 100. Geographic Occurrence.

288. World's Oil Reserves. V. R. Garfias. *Oil and Gas J.*, 23.2.33, **31** (40), 31.—Estimates of oil reserves are of practical importance, but whilst those of possible reserves are often inaccurate, appraisal of proven reserves can be made with an increasing degree of accuracy. In an accompanying table a list is given of the countries at present producing oil in commercial quantities in the order of magnitude of proven reserves, which are stated. In addition, the total production to the end of 1932, the 1932 production and the number of years of past production are stated for each country. The total proven reserves are estimated at approximately 24,000 million brls., a quantity which is only slightly in excess of total production to the end of 1932. The figures pertaining to several of the more important producing countries are commented upon. The estimated proven reserves are shown to be equivalent to about 20 years consumption taking the 1932 rate as a basis. Such reserves are far from impressive when compared with the magnitude of the reserves of other essential products, and considered in conjunction with the probable future trend of consumption. Since the whole of the reserves could not be produced within the 20-year period, it is obvious that the discovery of additional supplies within the next few years is necessary to assure a more permanent supply in line with consumption. R. A. E.

289. Competitive Relationship of Coal and Petroleum in the U.S. Forecast to Year 1950. W. S. Hutchinson and A. J. Breitenstein. *Oil and Gas J.*, 23.3.33, **31** (40), 30.—Figures are presented to show the annual consumption of mineral fuels of various types, the annual energy demand and the quantity supplied by coal, petroleum products and hydro-power respectively, the annual consumption of various types of fuel per head of population, and the population of the U.S.

The data is presented for the years 1850/1930 at intervals of 20 years and forecasts for 1950 are prepared. The totol energy demand and the supply obtained from each source have been calculated on a B.Th.U. basis from a knowledge of the consumption in terms of the normal units of measurement and the efficiency of use with relation to time and according to character of use. The annual figures for total energy demand and for the energy obtained from coal, petroleum and hydro-power respectively are plotted on a graph to show the trends, and the curves are continued to show the authors' forecasts for 1950.

Energy consumption per annum per head of population from each source have been calculated for recent years, and the results appear to show certain well defined trends, especially when considered in relation to total energy demands, and rate of growth of population. As illustration, the percentages of the total energy demand for the years 1900, 1930 and 1960 (forecast) derived from coal are stated to be 91·3%, 60·3% and 46·6%, from petroleum and its products 4·3%, 31·6% and 45·3%, and from hydro-power 4·4%, 8·1% and 8·1%, respectively. It is, therefore, anticipated that there will be little growth in the coal industry during the next 20 years, whereas petroleum is expected to double its market during the same period, if the estimates of petroleum reserves expected to be available at low cost for 20 years are accepted. R. A. E.

290. Crudes of Paraffin, Naphthene and Mixed Base Available for Refining in Trinidad Fields. E. F. Nelson and G. Egloff. *Oil and Gas J.*, 2.2.33, **31** (37), 12.—The main oil deposits in Trinidad are the Fyzabad, Parry Landa, Pitch Lake and Palo Seco fields, which are grouped around the Pitch Lake.

The yields of products from three typical Trinidad crudes and the quality of benzine obtained by straight distillation of a Trinidad crude by cracking (*a*) the crude; (*b*) the topped crude; and (*c*) the gas oil are given.

The paraffin base crude—Tabaquite (see *J. Inst. Petr. Techn*, 1924, **10**, 515) yields 32.6% gasoline, 28·4% kerosine, 16·0% gas oil and 21·8% of lub. oil distillate, while a mixed base crude gave 41% of gasoline and 15% of kerosine, and a naphthene base crude 12% of gasoline, 14% of kerosine and 37% of gas oil.

The crude oils used in the cracking tests gave the following yields of benzine—300° E. Pt. 7·6%, 350° E. Pt. 16·5%, 400° E. Pt. 22·0%, of octane number 70, 69 and 68 respectively, the percentages distilling to 100° C. being 48%, 24% and 12%. The crude oil, topped crude oil and gas oil gave the following yields of gasoline, 51·1%, 45·0% and 58·9% of octane number 85, 87 and 91, the boiling range of the gasolines being 90/382, 92/400 and 90/390 °F. The cracked residues were of high quality with pour points of 45°, 25° and 5° F. respectively and B. S. & W. of 1.0, 0.6 and 0.4%. C. L. G.

291. Geological Studies of the Baku Oil District. W. W. Weber. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series A, Paper 8.—The paper provides a survey of the geological investigations of the district up to date, describes the indications of the existence of petroleum in various strata, and discusses the commercial possibilities of the various parts of the region. P. A.

292. Geological Survey Along the Eastern Coast of Kamtchatka (Malaya Chajma Storoj). B. A. Alfiorov. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series A, Paper 15.—The author describes and gives a geological map of the basins of the rivers Malaya Chajma and Storoj. In the course of his investigations the author found no evidence of the presence of petroleum or bituminous substances in general in the district under consideration. P. A.

293. Geological Survey of the Region Within the Limits of Sheet D-2 and of the Eastern Part of Sheet E-2 of the Five-versts Map of the Caucasus. W. A. Kousnetzov. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series A, Paper 24.—A record of a survey and a geological map of a district in the Northern Caucasus covering approximately 12,000 sq. miles are given. P. A.

294. Character of the Deposition of Petroleum and Sections of the Petroleum Strata of the Vosnesensk Oil Region. L. S. Petrov, *Trans Petr. Geol. Res. Inst., Leningrad*, 1932, Series A, Paper 28.—The petroleum-bearing area of the district is estimated to be roughly 580 hectares. Since some of the sections overlap each other the total area might be considered to be 820 hectares. The crude may be directly used for lubrication being of an oily nature. In order to exploit the fields it would be necessary to erect a small oil refinery on the spot, since otherwise a costly line of large cross section has to be constructed. P. A.

295. Emba Petroleum Region. Asche-sai and Kara-oba. S. W. Shumilin. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series B, Paper 6.—A record of a survey of the district and a geological map are given. No signs of petroleum were found in the region. P. A.

296. Geological Survey of Kalmuk-Sal Steppes. F. F. Golinetz. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series B, Paper 7.—Definite indications of the presence of petroleum were found in the district. The paper provides a detailed record of the survey. P. A.

297. Data of the Survey Drillings for Gas and Petroleum in Astrachan Region and Prospects of a Further Survey Within the Lower Volga Basin. P. A. Pravoslavlev. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series B, Paper 7.—Indications of the presence of gas were found in many places of the district. Since there is a distinct possibility of the existence of structures favourable for the accumulation of gas and possibly petroleum a geological survey is indicated. A systematic analysis of gas from the existing outlets may provide some data for the genesis and occurrence of gas. P. A.

298. Brief Description of the Geological Structure of a Strata of Chalk Deposits between the rivers Fortanga and Gekha in the Northern Caucasus. L. A. Grechishkin. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series B, Paper 27.—The paper provides a record of a geological survey. Geological map and sections are given. P. A.

299. Geological Survey to the South of the Maikop. P. I. Shibinsky. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series B, Paper 28.—Favourable conditions for the occurrence of petroleum were found in the region of the Kurjip Anticline. P. A.

300. Products from Estonian Shale Oils. G. Egloff and E. F. Nelson. *Oil and Gas J.*, 12.1.33, **31** (34), 14.—Oil shale was discovered in Estonia in 1790, but was not exploited until 1916 when there was a severe fuel shortage. The largest mine and plant in Estonia at Kohtla has been operated by the Government since 1919, other concessions being made later to private companies at Vanamoisa, Pussi and Sillamagi.

The shale deposits cover an area of 2400 square kilometres from Kadrina on the west of Narwa on the east, and occur in seven seams interspersed with limestone bands, located in the Ordovician system. The crude Estonian shale is soft, light to dark brown, and burns easily with a calorific value of 3000–3500 cal. for the freshly mixed shale and 4200–4250 cal. for the air dried shale. The state owned plant at Kohtla operates six Pintsch producer retorts while the plant at Pussi operates on the Eesti Patendi A/S system and that at Tallium with the new Davidson rotary retorts.

The properties of the crude oil from the Kohtla plant and of the products obtained therefrom are given. The crude oil has the following characteristics, sp. gr., 1·0; fl. pt., 181° F.; visc. at 122° F. 5° E.; S., 1.0%; cal. value, 9600 cal. It contains very little gasoline, the chief marketable products being, Diesel oil, lubricating oil and Estobitumen. The Diesel oil has a sp. gr., 0·93/0·95; S., 0·9%; coke, 3–4%; cal. value, 9700/10,000 cal.; with 40/58% dist. to 572° F.

Estobitumens of various melting points are produced by air blowing the crude oil, pitch and phenolates used as wood preservatives being also produced.

The oil from the Eesti Patendi retorts contains gasoline as well as light, heavy and medium oils. The crude gasoline has the following properties: sp. gr., 0·767/0·770; S., 0·72/0·74%; unsat., 2% I.B.P. 118° F.; 21·5/25·2% to 212° F.; E. Pt., 428° F.

Cracking tests on crude and topped shale oils were carried out, 22% Str. run benzine of 392° F. E. Pt. being removed (28·3% of benzine of 432° E. Pt.). Although the benzine has an octane number of 69/72, the gum (430/510 mgms. per 100 ml.), and the content of tar acids (3·5/5·3%) render it unsatisfactory and requiring acid treatment to meet specifications.

The crude shale gave a yield of 42·7% of gasoline of 73 octane number and the topped shale 27·4% of 74 octane number.

The benzines had I. B. Pts. of 116° F. and 106° F. respectively, 25% and 19% to 212° F. and E. Pts. 390 F. and 396° F. C. L. G.

301. Asphalt Discovery in Sinai. J. P. Mitchell. *Roads and Road Constr.*, 1.3.33, **11** (123), 75.—It is stated that a mountain of asphalt has been discovered near the oil wells of the Abu Durba field in Sinai (see *J.I.P.T.*, Abs., 1931, No. 1160). Several test holes have been drilled and cores obtained, while blasting operations on the rock have led to the conclusion that probably half a million tons can be quarried and much larger quantities may possibly be obtained by mining operations in the lower strata of the adjacent hills. The asphalt appears to be a quartz sandstone impregnated with a hard and non-ductile bitumen. The extracted bitumen has a penetration of 7 and nil ductility. The bituminous sandstone breaks down rapidly under heat and when mixed with a small proportion of the bituminous oil from the adjacent oil wells makes a paving material very similar to the Kentucky sandstone asphalt called Kyrock. Technical experiments are in progress to determine the value of the material, but commercial exploitation is hindered by the absence of transport facilities. C. L. G.

See also Abstract No. 361.

Class 200. Geology and Origin.

302. Aircraft in Relation to Petroleum Technology: Use for Survey and Transport. H. Hemming. *J. Inst. Petr. Techn.*, 1933, **19**, 73–116.—An informative lecture, with discussion, on the use of aircraft in the survey of oilfields. It is shown that air surveying provides an excellent method for obtaining information of practical value to the petroleum geologist and engineer. G. R. N.

303. Cosmic Genesis of Petroleum. W. H. Jeffery. *World Petroleum*, Feb., 1933, **4** (2), 55.—The author discusses the three theories generally held to account for the formation of petroleum deposits—viz., the organic, chemical and volcanic theories—and adduces evidence from well-known authorities to discredit the existing theories. He explains his theory of the cosmic formation of oil, which is, in brief, that natural gas is a product of the hot gases of which the earth consisted at its formation, and that petroleum is the result of high compression of this gas, the process being still in existence.

The organic theory, which is the most widely accepted, is supported by the formation of bituminous coals from vegetable matter, the production of ichthyol in the fish beds in Poland and the methane derived from decayed vegetation. On the other hand, the tissue of inorganic matter normally decomposes very rapidly before it could possibly be covered with sediment or otherwise imprisoned in the strata in the process of formation. The entombment of organic remains during volcanic activity or earth convulsions could only account for a very small percentage of the total oil imprisoned in the earth. Eugene Coste (*Volcanic Origin of Natural Gas and Petroleum*. J. Can. Min. Inst., Vol. VI.) points out that if the gas and oil were distilled from the vegetable matter imprisoned in the strata of the carboniferous period, a residue of coke should be left in the rocks, whereas such a residue has never been found. Also, this would not account for the hydrocarbons in the pre-carboniferous rocks, in volcanic emanations or in meteorites. Geikie points out that the chance for the preservation of remains of the present flora and fauna on land must always be very local. On the sea, particularly

in sedimentary belts near the continents and where tracts rise near the surface of the ocean, conditions suitable for the preservation of plant life exist. The A.P.I. report on Origin and Environment of Source Sediments, however, has decided that cellulose and its decomposition products are present in very small amounts in marine sediments, and that organic matter is deficient, so that such sediments cannot be considered as favourable source material for the formation of oil.

The inorganic theory is that petroleum and natural gas are the result of chemical reactions between water and the large quantities of calcium, iron and other carbides, which are postulated to exist in the earth. Moissan has succeeded in forming artificially metallic carbides which are readily decomposed by cold water, yielding various gaseous or liquid hydrocarbons. At the same time, however, it must be remembered that water at high temperature and pressure becomes a powerful acid, and therefore would react very differently in the earth from laboratory experiment. The enormous quantities of oil both already recovered and that recoverable render both the organic and inorganic theories inadequate.

Coste advanced the volcanic theory of the origin of petroleum and alluded to the similarity between high-pressure gas and oil blow-out conditions and volcanic manifestations. The author, however, believes that natural gas is primordial—*i.e.*, a natural product of the hot gases of which the earth consisted at its birth—and that petroleum is the result of compression at high pressures of the gas.

There are many hypotheses as to the origin of the earth, but most of them presuppose the genesis of the earth in a nebula which is essentially gaseous.

There are also many theories as to the physical state of the material at the centre of the earth. It is known, however, that hydrogen, helium and carbon are present in vast quantities in the sun, while volcanoes discharge hydrogen and carbon or these elements in combination with other elements. It is apparent, therefore, that these elements are contained within the earth. The simplest hydrogen-carbon compound, methane, exists as marsh gas and fire damp and as the main constituent of natural gas, and can be directly synthesised at temperatures over 1000° C. At the high temperatures existing a few miles below the earth's surface vast quantities of gas must be constantly driven off.

The author believes this to be the cause of volcanic action and the source of the natural gas or petroleum forced through faults and fissures into the present productive formations. Further evidence is afforded by the existence of crystals embedded in granite and lava, which contain great numbers of excessively minute cavities containing water or liquefied hydrocarbon oils or liquid CO_2 under great pressures.

There is geological evidence—*e.g.*, the oilfields developed along the Balcones fault in Texas—to show that the oil has been gathered in the interior of the earth and has escaped upwards to the stratified rocks where it now lies.

It appears reasonable to suppose that the generation of petroleum is a continuous process, and that hydrocarbons may find their way by new faults into sandstones and limestones which are now barren. C. L. G.

304. Origin and Environment of Petroleum Source Sediments. M. E. Kelly. *J. Instr. Petr. Techn.*, 1933, **19**, 117–141.—An account of published work on the origin and environment of petroleum source sediments. It is concluded that source sediments may be derived from accumulation of organic debris, fine sediments and dissolved salts in deep enclosed sea-floor basins near land, desiccation accumulation of algæ in present lagoonal and fresh waters, and accumulation in bottom waters, which, through geosynclinal changes, receive no oxygen. G. R. N.

Class 300. Development and Production.

305. Electrically Operated Gun Proves Effective for Perforating Cemented Casing in Hole. W. A. Sawdon. *Petr. Eng.*, Feb., 1933, **4** (5), 64.—After considerable experimental work, a perforating gun has proved its practicability by perforating three strings of casing and cement.

The perforations made by the Lane Wells perforating gun were 0·45 in. diameter and the bullets had to penetrate the 6¼ in. casing, the cement between it and the 8¼ in. liner, the liner itself, the cement between the liner and the 10 in. casing, the 10 in. casing and the cement between this string and the walls of the hole. The shots were fired alternately on the opposite sides of the casing.

The instrument consists of a series of perforating units threaded to each other and to a casing containing a control mechanism. The bullets are driven by a powder charge which is detonated by electrically energised thermal elements. It is lowered into the well on an armoured steel cable which carried a conductor for the electric current. The control mechanism contains a solenoid and an arm which operates a ratchet. When the current is next applied the arm engaging the ratchet advances the contact finger to the next contact at which time the second shot is fired.

Assurance that each shot has fired is indicated by ammeter reading. The voltage during the operation remains constant, so the amperage will change with the resistance and the resistance of each shot is eliminated when the shot is fired. Change of amperage indicated on the ammeter then shows that the shot has actually been made.

The gun is hermetically sealed so that it can be used under great fluid depths.

If desired, the hoist apparatus and firing mechanism can be so arranged that a series of shots can be fired consecutively at given intervals of time, while the gun is being raised and without halting its movement, thus preventing any possibility of "sanding up." L. V. W. C.

306. "Sub-Circulator" Rotary System Avoids Pollution of Producing Formations. Anon. *Oil Weekly*, 6.2.33, **68** (8), 10.—Owing to the plastering effect of rotary mud fluid, drilling in low-pressure areas became a difficult proceeding. In the high pressure areas the zones may be able to clean themselves, but even these zones may at times be damaged during drilling.

The sub-circulator system was designed to prevent pollution of the oil zones and to enable the nature of the fluids entering the hole to be determined.

An air compressor displaces the mud circulating equipment, and air under pressure is used to force the liquid from the drill pipe into the casing during drilling. In the drilling string are placed two valves, the upper being an inlet valve and the lower an exhaust valve.

When the pressure has built up sufficiently in the air compressor tank, the check valve is opened and compressed air is forced into the drill pipe. The inlet valve, which is placed about 200 ft. below the average fluid level, closes, and the exhaust valve opens, allowing the fluid inside the drill pipe to be driven out, thus washing the cuttings away from the bit. When the air is cut off at the surface, the inlet valve opens and permits fluid to enter the drill pipe again. There is thus a continuous circulation of fluid from the drill pipe to the casing and then to the drill pipe again.

When a specified distance has been drilled, a bailer is run to clean the hole.

This system was used successfully by the Union Oil Company of California.
L. V. W. C.

307. Preparation of Rotary Mud. L. G. E. Bignell. *Oil and Gas J.*, 2.3.33, **31** (41), 36.—One problem which has confronted the driller has been to secure samples of cuttings of the formations being drilled for the benefit of the geologists. With cable tools, cuttings are obtained by dumping a portion of the material brought up in the bailer into a bucket. This method does not permit the securing of any appreciable portion of the very fine material because the washing is usually done by agitating the material in the bucket with a stream of water under high pressure, and the excess water is permitted to flow over the bucket edge at high velocity, carrying with it practically all the fine particles. Thus a true sample of the formation is not possible.

To secure rotary cuttings the usual practice is to pass a bucket across the end of the flume or pipe discharging the mud fluid into the slush pit. The sample is then washed as before. Unfortunately much depends upon the driller, and objection to taking samples has resulted in poor logging.

To overcome this a number of semi-automatic sampling devices have been developed. These devices cannot develop their greatest efficiency if the stream flowing is contaminated with large quantities of material from formations other than the one in which the drill is cutting at the time the sample is secured.

To remedy this condition, more andl arger settling pits with proper levelling and spacing of baffles to reduce the rate of flow have been constructed. Also jetting of the material from the circulation pits into reserve pits, and the washing of the suction pit have been resorted to. This has helped by removing much of the coarse material formerly held in suspense and recirculated.

When penetrating soft formations with a rotary drill, the walls of the hole fall and result in the cross section of the hole being greater than it should be. This results in the velocity of the up current being reduced, and this in turn reduces the carrying capacity and the size of the particles it can handle.

To overcome this caving and so improve the sampling, the walls must be properly plastered, and efficient mud fluids are therefore necessary. In a hole of constant cross section between drill pipe and walls the velocity, and therefore the carrying capacity, will remain constant.

Thus even though greater amounts of power are possible with increased weight and quality of the drilling equipment, the use of proper mud mixtures will give added efficiency and will enable the geological department to log the well with greater accuracy. L. V. W. C.

308. Special Precautions needed in Drilling to Prevent Drainage to Water Supply. W. A. Spinney. *Oil and Gas J.*, 23.2.33, **31** (40), 52.—Special features were required for a well drilling in Cushing due to the location of the well. This well was located in the drainage area which supplies the waters of the lake and it was necessary to resort to unusual methods to protect the water from any kind of pollution and also to provide future protection if the well should become an oil producer.

A cement wall was built part way round the rig location and the slush pits, the rig foundation was of concrete and the concrete floor extended from the rig for a distance of about 40 ft. A 12-ft. corrugated iron fence was placed on top of the cement wall and thus any splashes from the drilling operations were confined to the rig.

To give added protection the derrick was enclosed for more than half way to the top with corrugated iron sheets. In addition the rig floor was scrubbed each tour and all the equipment was kept clean at all times.

L. V. W. C.

309. Deep Well Brought in Through Tubing by New Method. L. G. E. Bignell. *Oil and Gas J.*, 23.2.33, **31** (40), 50.—Due to the reduced bottom hole pressure in the Wilcox sand and the increased gas-oil ratio of the wells producing from this sand in the Oklahoma City field it is proposed to tube and produce wells under back pressure to conserve gas and control water movement as much as possible.

One well was completed with a cemented 6¼ in. string and a flow string of 2½ in. tubing fitted with kick-off units of the two-way type placed every 300 ft. up the tubing from the bottom, with the top unit 970 ft. from the top of the hole. The tubing was connected with a gas line string from an adjacent well located about 300 ft. away, having a casing head pressure of about 1300 lbs./sq. in. This was the only compressed gas used in the operations and the highest pressure built up within the tubing at any time during the clean-out period was 950 lb.

The mud in the hole was removed by the use of the string of tubing and the kick-off units.

The hook-up at the well head consisted of a combination ram and seal on the casing and above this a joint of casing to form a lubricator. The upper part of this casing was fitted with a second tubing control head and during the tubing operations this upper unit carried the tubing slips.

To obtain the most efficient gas oil ratio in flowing the well through the tubing it was found necessary to raise or lower the string until the most desirable position to give the best production results was obtained. Special fittings were placed at the bottom of the tubing and so long as the valve in the fitting was held against its seat no fluid or gas could enter the bottom of the string of tubing. This valve was kept in the closed position as the tubing was being run into the hole and when the tubing was landed the free valve fell and allowed oil and gas to flow into the string. L. V. W. C.

310. Some Factors in Extinguishing Oil Well Fires. M. M. Kinley. *Petr. Engr.*, Feb., 1933, **4** (5), 64.—At the outbreak of a well fire the field staff should adopt some emergency measures until the arrival of the expert fire fighters. These measures should have as their object the confining of the blaze to the well and the prevention of the spread of the fire to other wells or surrounding property. By this means the task of extinguishing a burning well is greatly expedited.

The first task in fighting an oil well fire is the removal of the steel debris, and this is one of the most hazardous of jobs. After removal of the heated steelwork to a safe distance the actual work of extinguishing the fire may be started. L. V. W. C.

311. Contributions to Sub-surface Studies by means of Electrical Measurements in Drill Holes. C. and M. Schlumberger and E. G. Leonardon, *A.I.M.E. Tech. Publ., No.* 503.—Two aspects of electrical coring, one of scientific and the other economic and statistical interest are worth emphasising.

The differences of potential spontaneously generated in drill holes are caused either by filtration of fluids through the porous layers or by osmotic electromotive forces generated at the contact of liquids that do not contain the same percentage of dissolved salts. According to circumstances, one or other of these phenomena takes a predominant place. When the electromotive forces of filtration are predominant the pressure in the formation may be determined. When the osmotic forces are greatest it is the salinity of the water that can be measured. Where these two forces are practically equal it is only possible to give a rough quantitative estimate of the pressure and the salinity. No matter what the conditions may be the diagram of the differences of potential spontaneously generated in drill holes gives all the

porous layers traversed by the drill hole with accuracy. The utility of this diagram supplements the information given by the resistivity diagram.

Electrical coring can render valuable services for the exploitation of oil fields where geological correlations are very difficult to establish. In the Russian fields electrical coring has either eliminated or considerably reduced mechanical coring for 90% of the oil production of the Soviet Government.

L. V. W. C.

312. Present Tendency in New Production Methods. R. M. Carr. *Oil and Gas J.*, 23.2.33, **31** (40), 33.—Depths from which oil is produced continue to increase and economic conditions require that costs of investigations be limited, while low prices for the product demand that producing methods be carefully considered to the end that lifting costs be brought to the absolute minimum. This combination of circumstances during the past two years has brought about notable progress. One development of importance is that importance of formation gas energy in oil recovery has been stressed to almost universal realisation. Open flow has given way to restriction of flow for the dual purpose of holding production within limits of demand and also of conserving energy. Gas lift methods are being extended to application to lift principles which reduces the working parts in pumping wells to only one. In addition, conventional pumping equipment is being overhauled and redesigned with a promise of greater efficiency. L. V. W. C.

313. Flowing of Wells. S. F. Shaw. *Petr. Eng.*, Feb., 1933, **4** (5), 16.—There are two types of intermittent flowing in use at the present time :—(1) Periodic flowing of the well through tubing or casing. No chamber or standing valve is placed at the bottom of the string with this type of operation ; (2) The use of two concentric strings inside the casing, with a chamber attached to the lower end of the outer string of tubing and with a standing valve at the bottom of the chamber. The air or gas is intermittently admitted to the annular space, and the oil displaced from the chamber into the inner string of tubing.

The first type of intermittent flow is more common with the larger producers, whilst the second type is employed when the production has declined to less than 150 lb. per day. The consumption of gas per barrel lifted has been found to be less when using the second type than when using either continuous flow or the first type of intermittent flow.

As well depths increase the use of intermittent flow will receive increased attention on account of the lower operating costs from such flow.

L. V. W. C.

314. Proper Diameter Pump for the Oil Well. A. Allen Junr. *Oil and Gas J.*, 23.2.33, **31** (40), 40.—Oil wells that are produced by pumping may be roughly classified into those which have been prorated and marginal wells.

Due to the low price of oil, marginal wells, in many cases, are producing at a loss, and in order to reduce operating costs the cost of pumping the well must be considered.

Sucker rod breakages constitute a very large expense and ways of reducing such breakages must be sought. Improvement can be obtained by either slowing down the well and increasing the volumetric efficiency of the pump by keeping the pump in a better state of repair. By increasing the length of stroke and reducing the number of strokes per minute, which nearly always causes more surface rig trouble and usually requires smaller pulley sizes and more surface counterbalance and heavier equipment throughout. Or to reduce the effective diameter of the pump and use a slightly longer stroke.

By reducing the diameter of the pump the load lifted on the upstroke is reduced, whilst the down stroke load remains approximately the same. Thus the amount of counterbalancing is reduced, and the prevailing type counterbalance is able to balance the well more closely and so allow a more uniform flow of power through the surface transmission equipment.

Another factor which enables wells to produce the same amount of fluid, with a reduced pump diameter at the same pumping speed, is the increased plunger speed obtained. This increase makes possible the running of a well at a speed at which the deceleration of the sucker rods during the lower half of the down stroke is sufficient to throw them into enough tension as they come to a stop at the bottom of the stroke to insure that they will be more elongated at the bottom of the plunger stroke than they are at the top, thus giving greater plunger travel for the same maximum rod stress. Unfortunately the steel is unable to withstand these repeated loads, and it is possible that the lower maximum rod stress obtained with a smaller diameter pump will more than counteract the greater number of times at which the rods are subjected to this stress.

The simplest method of reducing the sucker rod load and the surface equipment load is to install a pump with the proper effective diameter.

The deeper wells demand more care in the choice of the correct pump diameter, and when this care is given better pump efficiencies are obtained and an increased amount of fluid is recovered with less effort. L. V. W. C.

315. Straight Line Volumetric Displacement for Reciprocating Pumps. J. E. Holveck. *Oil and Gas J.*, 2.3.33, **31** (41), 36.—To overcome the excessive fluctuations in pressure present in reciprocating pumps the Holveck compensator has been developed.

This compensator consists of an auxiliary pump operating in a cylinder open to the discharge manifold of the pump. Attached to the plunger is a roller in contact with a cam keyed to the pump crankshaft. Pressure in the discharge line acting on the plunger maintains continuous contact between the cam and the roller. A spring, counteracting against the plunger, eliminates any excessive thrust against the cam. The net difference between the load on the plunger and the spring compression need only be sufficient to keep the roller in constant contact with the cam.

The movement of the compensator plunger by means of the cam is synchronised with the pump crankshaft.

The contour of the cam with its relative action on the compensator plunger is such as to eliminate all variations in rate and volume of pump displacement above and below the mean at the time such variations occur, in exact synchronism with the crank movement of the pump. L. V. W. C.

316. Power Transmission Assemblies on Pumping Wells. V. D. Bennett. *Petr. Eng.*, Feb., 1933, **4** (5), 32.—With a curtailment of oil production it is necessary that well operating expenses be reduced to a minimum.

One of the most important phases of well operation leading to economies is an understanding of the relationship of a correct power transmission assembly to efficient engine operation and also the elimination of sucker rod trouble.

A correct power transmission assembly for wells should be selected to obtain a slow motion of the rods and surface equipment, and at the same time get efficient performance from the prime mover.

Sucker rod breakages are reduced, if not eliminated, and, in addition, assistance sometimes results from the assistance that the weight of fluid outside the tubing lends in lifting the column of fluid inside the tubing.

Where slow running is obtained by cutting down the speed of the prime mover three undesirable conditions are produced. When the speed of a gas engine is reduced below that recommended, the pressure must be increased, and this causes heavy pounding. Secondly, this low speed results in highly overloaded condition of the engine; and, thirdly, slow running of the engine has a detrimental effect on pumping equipment and sucker rods.

Thus although a slow pumping speed is conducive to economy, it should not be attained at the expense of inefficient engine operation. L. V. W. C.

317. Installing Central Powers. K. C. Sclater. *Petr. Eng.*, Feb., 1933, **4** (5), 22.—The low price of crude and prorated production have created a demand for central powers embodying up-to-date engineering features conducive to low operating and maintenance costs.

In order to obtain the most economical installation, sites for the power must be chosen with care. In addition it is necessary to know the number of the wells, their loads and pumping characteristics, their relative location with respect to each other and a knowledge of the topography of the lease.

All modern power installations are of all-steel construction. Shackle lines are so laid out that they are kept in proper tension and lost motion is thus reduced. On long spans the catenary curves of the pull rods are sometimes determined in order to accomplish this.

A description of a number of recent installations is given.

In every power that is now being installed care is taken to see that everything is in proper alignment and is so laid out that it will be easy to maintain in alignment. Settling of the foundations is prevented by making them heavy enough, since settling causes misalignment which usually results in a serious loss of power. Loose shackle line equipment also transmits shock and stresses to the pumping equipment in the well that may result in much unnecessary rod trouble and expensive pulling jobs. L. V. W. C.

318. Chemically Treating Cooling Waters for Pumping Engines. H. M. McClain. *Oil Weekly*, 20.2.33, **68** (10), 13.—The general problems encountered in the operation of a pumping engine, while using a hard, untreated cooling water, are: (1) Replacement of cylinder heads, cylinders, piston and piston rings; (2) high oil consumption; (3) low operating efficiency of engine.

It is believed that the scale accumulated in the water jackets of pumping engines creates a high operating cost, and the importance of removing the scale from the water jackets and treating the water to prevent the depositing of the scale has not received sufficient consideration by the operators of pumping engines in the oilfields.

In every case, where engines have been cleaned of scale, and the water treated, the results obtained in the way of reducing general repair, oil consumption and increasing the operating efficiency of the engines have been remarkable. This being the case, the problem remained to find the most practical and economical method for cleaning the water jackets and treating the cooling water. L. V. W. C.

319. Behaviour of Occluded Gas in an Oil Sand Reservoir. I. I. Gardescu. *Petr. Eng.*, Nov., 1932, **4** (2), 22; Dec., 1932, **4** (3), 23; Jan., 1933, **4** (4), 28; Feb., 1933, **4** (9), 59.—The three conceptions regarding the mechanism of propulsion of occluded gas bubbles in an oil sand reservoir refer to the reservoir as a whole and not to the particular area surrounding the well. The conditions of flow in the area immediately surrounding the well are probably very different from those of the drainage area of the reservoir, and although it is important to know these conditions of flow it is equally

important to understand the conditions under which the oil is transmitted from the various parts of the drainage area towards the well.

The author has put forth a new conception of the mechanism of flow, which may be summarised as follows :—

The bubbles of occluded gas will remain stationary as the oil flows through the reservoir sand, because of their resistance to distortion and the relatively small pressure gradient exerted against them by the surrounding fluid medium. Only when the differential pressure, which varies according to the size of the occluded gas masses, is sufficient to overcome resistance to distortion can the gas masses move. These gas masses tend to remain stationary under conditions of flow the rates of which exceed the normal encountered in natural oil reservoirs. Only when the gas bubbles are subjected to a higher differential pressure, such as may occur in the immediate vicinity of a flowing well but not at any appreciable distance from the well, may they be forced through and out of the sand. Since occluded gas merely alters the apparent permeability of the rock the flow of oil through the reservoir sands follows the general laws of flow of dead fluids.

The physical properties of the oil as a flowing medium remains unchanged as if the free gas were non-existent, and by-passing of gas is not possible because occluded gas bubbles are retained by the sand pores. Only so long as occluded gas occurs as individual gas bubbles are these statements true. When large gas masses are developed an entirely different set of conditions is encountered.

Before tapping the oil reservoir the gaseous hydrocarbons accompanying the oil may occur either as free gas or dissolved gas. Free gas occupies the high parts of the producing horizon and dissolved gas is contained in solution with the oil. In addition it is suggested that free gas may also occur in the form of small disseminated bubbles generally referred to as occluded gas.

Diffusion of gas through the oil is slow, but considered over geologic periods becomes a factor of importance. Gas molecules go into solution in regions of high concentration and come out of solution in regions of low concentration.

It is difficult to conceive how occluded gas bubbles of higher gas concentration than that of an assumed large gas mass in association with the oil may possibly exist.

Gas bubbles formed within the oil mass have internal pressures higher than that of the surrounding oil, due to surface tension forces. The concentration of gas molecules in the oil corresponds to its pressure of saturation, whilst the concentration of gas molecules inside the gas bubble corresponds to a higher pressure. A bubble cannot exist, therefore, under these pressure conditions, because diffusion of gas would immediately take place from the bubble into the surrounding oil.

With a lowering of pressure in the reservoir, the concentration of gas molecules in the oil remains constant until free gas is evolved. The concentration of gas molecules in the gas bubble decreases as the pressure of the bubble is lowered.

Under ordinary conditions the surface tension will not be found constant, because the gas bubbles produced from solution generally evolve around a solid mass that serves as a nucleus. The important function of nuclei is to cause a lowering of the surface tension of the oil-gas interface at the points where the new gas bubble is to be formed.

From the experiments carried out it was seen that the rate of evolution of gas is not solely dependent upon the saturation of the oil with gas and the pressure of the reservoir, but also upon the presence of substances that act as nuclei in the formation of gas.

The next part deals with a study of the resistance offered by occluded gas. Gas bubbles and gas masses offer the same resistance to distortion, and this resistance can be calculated from the given formula.

The rate of evolution of gas depends upon two factors: (1) the concentration of gas molecules in solution, and (2) the area of the interface along which free gas may be evolved.

By-passing is the term used for gas masses moving through the reservoir under the action of buoyancy and differential pressure towards the well. Irrespective of position and distance from the well, buoyancy remains the same for gas masses of equal size, whereas the pressure gradient towards the well is maximum at the well and diminishes to zero with distance. Buoyancy is, therefore, the more important of the two forces in the portions of the reservoir some distance from the well, and consequently the gas in this area tends to accumulate toward the top of the sand. With an increase in distance from the well the pressure gradient increases and becomes of greater importance than buoyancy.

A series of experiments were undertaken and the results are given.

L. V. W. C.

320. Proration Based Upon Bottom Hole Pressures and Acreage. J. O. Lewis and H. F. Wright. *Oil and Gas J.*, 23.2.33, **31** (40), 45.—The authors are of the opinion that a system of proration based upon bottom hole pressure and production is equitable in principle and will be practical and substantially just in application. By controlling pressure in a pool, control is exercised over the causative agent for the recovery of the oil from the common source of supply. A ratio, determined for each property from the relation between the drop in pressure during a given time period and the amount of oil produced during the same period, is embodied in the system and is called the production-pressure ratio.

Illegal runs and unintentional errors are self corrective and over-produced wells will be indicated. Bottom hole pressure and production are the two factors employed.

L. V. W. C.

321. Determination of Bottom Hole Pressure. P. J. Jones. *Oil Weekly*, 6.3.33, **68** (12), 18.—The analysis given in this article brings out the fact that the pressure at the lowest point through which the extraneous gas enters the tubing is given by $P_b = P_t e^{KL}$ for ordinary working conditions of gas lift, where P_b is the pressure at the bottom, P_t the pressure at the top, L is the length of tubing and K is the constant of proportionality. The bottom pressure thus computed is greater than the actual pressure by 2 or 3 lb./sq. in. This difference arises from the neglected loss of pressure due to friction. The simplicity of this equation commends itself for practical utility.

L. V. W. C.

322. Instruments for Measuring Subsurface Pressures. Anon. *Oil Weekly*, 20.2.33, **68** (10), 20.—Subsurface pressure instruments may be classified as follows: (1) Maximum registering; (2) indicating; (3) selective or intermittent recording; (4) continuous recording; (5) continuous indicating and recording.

The maximum recording or registering type of instrument operates on a principle similar to that of a medical thermometer by indicating the maximum condition through which it is passed. The record is held until the instrument is manually altered in preparation for other tests. One type consists fundamentally of an inverted tube or shell, provided with a check valve at the bottom and a connection for attaching an indicating pressure gauge. The instrument is lowered into the well and a sample of fluid is admitted into

the chamber. As the instrument is started out of the well the check valve closes and the sample is trapped. At the surface the gauge is attached, the valve tripped and the pressure indicated directly.

Another type utilises the flexure of a square seamless alloy tube of high tensile strength to displace a fluid in a capillary tube. The loss of displaced fluid is measured directly. This instrument will read both maximum pressure and temperature.

A third type is more intricate. Pressure from without is admitted through the ports to a syphon bellows near the top of the instrument. This bellows acts as a seal between the well fluids and the lubricating oil retained between two sets of bellows. Pressure from the top bellows is transmitted through the oil to the lower bellows, the lower end of the latter being fastened to the body whilst the upper end is fastened to a rod. The upper end of the rod is fastened to a coiled spring, which in turn is fastened to the body of the instrument. Pressure transmitted through to the lower set of bellows compresses it downward, thus drawing the rod downward against the resistance of the coiled spring. A pin attached to the lower end of the rod actuates a pressure hand.

One type of indicating instrument was described in Abstract No. 556, 1932.

Instruments of the selective recording type record a series of readings at predetermined intervals of time. The main pressure element in one type is a Bourdon tube. An indicating gauge is attached and readings may be made successively.

A second type is arranged so that the well pressure is admitted at the inlet port and acts upon some soap solution contained in the chamber. The pressure then acts upon a piston attached to a coil spring. The lower end of the piston passes through a specially designed stuffing box into the chart drum chamber, and to the end of this is attached a stylus spring and stylus. The drum is rotated by mechanism and upon a sudden stop of the instrument or a jerk of the supporting line the drum is turned to a new position.

The principle parts of a continuous reading instrument are a clock, chart carriage, lead screw and pressure element.

A continuous recording with indication instrument has been described in *Inter. Petr. Tech.*, October, 1931, p. 547. L. V. W. C.

323. Treatment of Oil Wells with Acid. S. W. Putnam. *Oil and Gas J.*, 23.2.33, **31** (40), 8, 55.—As a means of increasing oil production, hydrochloric acid was used as far back as 1894, but not until 1932 was the procedure developed to make it a commercial success.

An attempt was made to reintroduce into the ground, brine from which certain raw materials had been extracted, and by having this brine take back from the rock these materials which it had lost it was thought that the brine supply could be conserved.

In the treating of oil wells, such factors as paraffin, sludge, open hole below the pay, brine encroachment, etc., had to be considered.

A new inhibitor was developed to cut down the action of the acid on the well equipment, and with this inhibited acid the strength of the acid was considered for each kind of rock.

It was necessary to include with the acid a surface tension breaker to allow the calcium chloride solution to come out of the rock instead of sealing itself in the pores and shutting off the oil.

The blend of acid must be considered for the particular type of rock it is to attack.

The next item of importance is the use of pressure in the application of the acid. At the bottom of the well a blanket must be placed in order to

direct the acid into the actual pay itself. This prevents the acid from going into the bottom of the well, and insures the effective use of all the acid which is put into the well.

Where paraffin causes trouble it is necessary to use a solvent.

L. V. W. C.

324. Migration and Encroachment of Water in the Bradford Sand. P. D. Torrey. *Petr. Eng.*, Feb., 1933, **4** (5), 27.—The amount of oil that may be recovered by water flooding is primarily dependent on the amount of oil left in the sand, but the efficiency of this recovery is directly related to the characteristics of the reservoir rock which will determine the degree of uniformity of water migration through the sand body.

The rate of water migration through the sand is dependent upon the uniformity of the sand and the continuity of the individual beds, porosity and saturation of the sand, permeability of the sand, the distance between input and outlet wells, and the volume of water introduced into the sand at varying pressures.

Flooding action will vary when there are large variations in porosity, permeability and oil saturation in individual beds, and as a result it is not uncommon to find the sand in cores taken in partially watered-out territory to be in all stages of depletion. In other words, the more permeable beds may be almost entirely saturated with water, the less permeable beds only partially saturated and the beds of low permeability containing little or no water. Irregularities in the continuity of the individual beds have a similar effect. In beds which change in lithology between the intake wells and the producing wells, oil will be concentrated at the point where the bed issues out or where the permeability decreased to the point where further migration is prevented.

The percentage of oil saturation in the sand has a very direct bearing upon the rapidity of water movement.

The distance between the input and the outlet well naturally effects the rapidity of water migration through the sand.

The water used in flooding operations is in general a very pure water in so far as dissolved mineral salts are concerned, and this water moving through the sand dissolves salts and comes into the well as a strong salt solution.

The precipitation of large volumes of mineral salts has reduced the permeability of the sands and the writer considers that migration and accumulation ceased not because of a diminishing amount of oil and gas available but rather to this decrease in permeability which effectively prevented any further movement under the natural pressures available. Precipitation of salts in the sand has probably reduced the permeability so that natural hydrostatic pressure is now insufficient to cause movement of water thus necessitating the application of artificial water pressure.

L. V. W. C.

325. Mining Petroleum by Underground Methods. G. S. Rice. *U.S. Bur. of Mines Bull.* 351, 1932.—As a method of extracting petroleum from sands or sandstones, mining has been studied for a number of years. Two of the most important fields where this method is being practised is the Pechelbronn Field in Alsace and the Hannover Fields in Germany.

In the Pechelbronn Field the oil-bearing marls are in the Oligocene formation of the Tertiary age and are in a great sunken monoclinal block of a former anticlinal structure. This block lies in the wide valley of the Rhine between the hills of the Black Forest and the Vosges Mountains. In the shallower workings the petroleum is a thick asphaltic oil with an average

density of 0·970; a little deeper there is a paraffin oil of 0·945 density and deeper still an oil of density 0·880.

In addition to the mines in this field there are numerous wells being operated on the pump.

The porosity of the Pechelbronn oil sands have been studied and the oil obtainable by wells and by mining was estimated. It has been estimated that a recovery of 43·3% was possible by mining which together with 16·7 from the wells made a total recovery of 60% of the original oil content.

The several oil-bearing sand beds range from 0 to 30 ft. in thickness and lie between limy marls. These marls of the roof and floor are apparently impervious to oil.

It was found extremely difficult to estimate the expected production of oil per unit of sand by weight or volume owing to the fact that in some instances wells from the surface were found to have completely drained a lens of sand when the mine headings reached it. On the other hand, wells sometimes failed to get oil from a certain area and yet a mine subsequently dug disclosed the fact that the area was saturated with oil.

The mine workings comprise a system of drainage levels and incline crosscuts which divide the oil-sand layers into more or less rectangular blocks of different sizes. Natural drainage and occasionally drainage forced by compressed air, are the two methods used for obtaining oil. The drainage pits range from 20 to 30 in. square and 6 to 8 ft. in depth, depending upon the thickness of the marl layer and of the oil lens below. Very little gas under pressure is entrained in the oil so that movement of the oil into the pits is chiefly by gravity.

In addition to drainage pits exploratory boreholes, 2 in. diameter, are used which are drilled up and down from the gallery at intervals of 66 ft. These boreholes may be deep enough to tap another sand. In the case of a "down pointing" hole the casing pipe is connected with the suction pipe line system and for an "up pointing" hole a packer is inserted in the casing in the borehole and connected to the nearest sump or pit.

Compressed air is used in some instances in conjunction with "down pointing" exploratory holes. The air is forced into adjacent boreholes and the oil drawn from the key holes. By this means the flow is increased, but no information is available as to whether the total recovery is increased.

Due to gases and vapours, the ventilation of the mines is an important matter and the system used in gassy coal mines is the one that has been adopted.

Inrushes of water, gas and oil have occurred and open flame lamps are not permitted in the workings. Advanced boreholes must be made in the face of the heading. Air-hammer picks have replaced the hand pick to reduce the danger of sparks and fire, and explosion doors are no longer insisted upon. Various other precautions are taken to insure the safety of lives and property.

The oil in the Hannover Fields is deposited in beds of sand, sandstone or clay sand. These beds are porous but the porosity varies widely.

The oil sands are in the form of lenses, thicker in the central part and diminishing laterally. The depth of the edge water, which marks the lower boundary of the oil zone, is from 60 to 800 metres.

Geological conditions are complicated and exact information is difficult to obtain because of overlying measures.

In the Holstein region oil was found in quantity in the chalk dome, but has not so far been worked.

Little or no gas remains in the oil beds, the lighter constituents having apparently escaped leaving the heavy oil with an asphaltic base. The specific gravity ranges from 0·94 to 0·88. The beds carrying the oil are

uncinerated sands, fairly coarse, have a high porosity and drain freely. The oil apparently extends downward in four sands.

The mine is developed from two vertical shafts about 842 ft. deep which intersect the four oil-sand beds. The ground temperature of the workings and the temperature of the mine air are above the average, but not uncomfortable for working. The hazards in the mine appear numerous, but the accident reports are good.

The conditions, favourable and unfavourable to mining in these two fields, are given in some detail.

Little mining has yet been carried out in the United States although numerous patents have been allowed. The Rannay method of mining oil has been tried in Texas, but unfortunately the mine was not a commercial success.

A discussion on the relative merits of mining and drilling for oil is included.

L. V. W. C.

326. Patents on Drilling Apparatus.—C. R. Solum. U.S.P. 1,895,526, 31.1.33. Drilling Bit having two sets of cutters so arranged that they rotate at acute angles with the axis of the drill string.

D. L. Die Homme. U.S.P. 1,895,610, 31.1.33. Drilling Bit.

W. Elliott. U.S.P. 1,895,615, 31.1.33. Crooked Hole. Indicator using a plumb bob and a liquid pressure to indicate crookedness.

E. E. Young. U.S.P. 1,895,905, 31.1.33. Well Packer.

R. P. Simmons. U.S.P. 1,896,104, 7.2.33. Cement lining for oil wells.

R. P. Simmons. U.S.P. 1,896,105, 7.2.33. Percussive well drilling apparatus.

R. P. Simmons. U.S.P. 1,896,106, 7.2.33. Core barrel well drilling apparatus.

R. P. Simmons. U.S.P. 1,896,107, 7.2.33. Under reamer.

R. P. Simmons. U.S.P. 1,896,108. 7.2.33. Well pump.

R. P. Simmons. U.S.P. 1,896,109, 7.2.33. Cutter head for drilling bit.

R. P. Simmons. U.S.P. 1,896,110 and 1,896,112, 7.2.33. Method of placing a filler above the cap rock and then drilling into the sand with a very small diameter tool, thereby permitting the gas pressure from the reservoir to be dissipated in the large-sized casing immediately after the small outlet.

R. P. Simmons. U.S.P. 1,896,111, 7.2.33. Method of maintaining oil wells in flowing condition and conserving their natural gas supply.

G. W. Woods. U.S.P. 1,896,212, 7.2.33. Cement well strainer.

J. H. Howard, E. A. Johnson and J. H. McEvoy. U.S.P. 1,896,236, 7.2.33. Retractable tubing head.

L. C. Huff. U.S.P. 1,896,237, 7.2.33. Pump valve.

A. A. McDonald. U.S.P. 1,896,243, 7.2.33. Cutter support for well drills.

F. L. Scott. U.S.P. 1,896,250, 7.2.33. Lubricator coupling for rock drill.

A. Toll. U.S.P. 1,896,469, 7.2.33. Telescoping core drill.

E. V. Crowell. U.S.P. 1,896,482, 7.2.33. Cement retainer.

G. A. Macready. U.S.P. 1,896,522, 7.2.33. Apparatus for obtaining samples from wells.

L. A. Rawson. U.S.P. 1,896,558, 7.2.33. Sucker rod pumping apparatus.

C. A. Dean. U.S.P. 1,896,703, 7.2.33. Core drill.

H. W. Parkin. U.S.P. 1,896,719, 7.2.33. Pump barrel and plunger.

I. C. Harris. U.S.P. 1,897,121, 14.2.33. A fluid operated rotary percussion drilling apparatus.

W. T. McCann. U.S.P. 1,897,206, 14.2.33. Casing cutter.

G. A. Montgomery. U.S.P. 1,897,322, 14.2.33. Torsion and coupling controlling device for well drill stem.

W. K. Morgan. U.S.P. 1,897,507, 14.2.33. A pump rod guide and paraffin scraper.

M. Myers and C. Myers. U.S.P. 1,897,854, 14.2.33. Temper screw handle bar.

A. G. H. Straatman. U.S.P. 1,897,871 and 1,897,872, 14.2.33. Apparatus for and method of obtaining orientation of drill cores.

H. C. Otis. U.S.P. 1,897,985, 14.2.33. Choke for oil wells.

H. C. Otis. U.S.P. 1,898,261, 21.2.33. Safety pulling tool for removing an obstruction in the well.

S. H. Williston and C. R. Nichols. U.S.P. 1,898,473, 21.2.33. Well surveying apparatus.

F. J. Wheeler. U.S.P. 1,898,649, 21.2.33. Method of landing oil well casing.

C. J. Gaarts and J. A. A. McKee. U.S.P. 1,898,926, 21.2.33. Method of making bore holes by converting the material in which the boring is taking place into a semi-solid condition by heating under a pressure superior to the pressure in the strata surrounding the bore hole.

H. C. Brewster. U.S.P. 1,898,937, 21.2.33. Disc bit drill head.

L. C. Tilbury. U.S.P. 1,899,065, 28.2.33. Well screen.

L. C. Tilbury. U.S.P. 1,899,121, 28.2.33. Back pressure valve mechanism for well pipe.

F. J. Hinderliter. U.S.P. 1,899,273, 28.2.33. Casing support and packing head.

J. H. Howard. U.S.P. 1,899,331, 28.2.33. Well drilling bit.

J. B. Ragsdale. U.S.P. 1,899,354, 28.2.33. Core catcher.

A. M. Grant. U.S.P. 1,899,438, 28.2.33. A motor operated rotary percussion system.

C. Erickson. U.S.P. 1,899,458, 28.2.33. Drill shank and bit.

W. C. Harper. U.S.P. 1,899,460, 28.2.33. Deep well pump.

H. Mecom and L. J. Black. U.S.P. 1,899,469, 28.2.32. Drill pipe joint.

V. B. Kibele and E. R. Ericson. U.S.P. 1,899,697, 28.2.33. Method of an apparatus for hydraulically pumping oil wells.

H. W. Sandstone. U.S.P. 1,899,728, 28.2.33. Fluid operated percussion method of drilling. L. V. W. C.

See also Abstract No. 365.

Class 400. Transportation, Storage and Distribution.

327. Welding of Vessels Containing Explosive Gases Made Safe by Carbon Dioxide. L. G. E. Bignell. *Oil and Gas J.*, 16.2.33, **31** (39), 13.—The dangers of explosion of hydrocarbon gases when carrying out acetylene or electric welding are being reduced by the admission of carbon dioxide into the vessel being welded. A non-explosive mixture is formed with 20% of CO_2 in hydrocarbon gases, but it is usual to use 40% for the sake of safety. When it is required to weld leaky gate valves on pipe lines, it is possible to tap the line and admit carbon dioxide and produce an inert mixture in the valve so that welding can be done safely. Similar methods can be applied to other vessels to be welded along the pipe lines in the refinery or field, the great advantage being that welding can be carried out *in situ*, without involving the expense of moving the part to be welded away from its position or that of shutting down a part of the unit. C. L. G.

328. Influence of Oil in Soil Corrosion. W. F. Rogers. *Oil Weekly*, 13.2.33, 68 (9), 12.—Crude oils and refined petroleum products have long been used under certain conditions to protect metals from corrosion.

In view of these facts, when a study was started of the mechanism of soil corrosion of buried pipe, it was assumed that any oil which leaked into the ground through collar leaks, split joints, etc., and ultimately found its way to the pipe surface would be protective in nature. Such, however, has been found not to be the case. The presence of oil in soils has been found to materially accelerate the rate of soil corrosion. Soils which would normally allow a pipe life of 20 to 30 years may become so changed through the addition of large quantities of oil that the pipe will become penetrated in five to six years. Many inspections have been made, and in no case has the presence of oil underground been found to exert a protective influence. The action of oil in accelerating the soil corrosion rate varies both with the type of soil and the quantity of oil present, although the minimum concentration necessary for corrosion to be accelerated has not been determined.

The discovery of the fact that oil can accelerate soil corrosion came about through inspections of pipe in an oil line being reconditioned. The discovery was made through the realisation that the type of corrosion which had occurred was too consistent to be a coincidence. Due to the possibility, however, that the action may have been due to the type of oil handled, the nature of the soil or other purely local features, other inspections were made to check the findings. The subsequent inspections were made on lines which handled oils of different kinds and were laid through different soil conditions. The findings have been so consistently the same that it is now regarded as established that the presence of oil can accelerate soil corrosion.

L. V. W. C.

329. Underwriters Approve Floating Roofs. Anon. *Oil and Gas J.*, 23.2.33, 31 (40), 30.—The underwriters laboratories have approved floating roofs and have listed them as inspected equipment of fire underwriters. The findings of the laboratory are given in its "Report on Floating Roof for Vertical Steel Storage Tanks," dated December 15, 1932. Details are given of the materials of construction, design and installation, and of the plan of investigation and examination of the test records. The conclusions state that the floating roof, composed of the materials, and designed and installed in the manner described, is practical to use on vertical steel tanks storing petroleum products. It is durable and records of service extending over a period of ten years testify as to its adequacy in regard to strength and rigidity. The floating roof will not permit the contents of the tank to support a continuous fire starting on the top. This conclusion is based on the results of fire tests and on the records of fires in service. Although hundreds of the roofs are in use, fires have been few, and the records available show that they were readily controlled and easily extinguished. The operation of the roof is not likely to start a fire as the possibility of sparks being struck by moving parts is remote, and metallic contact between roof and shell removes the danger from the generation of static charges. By blanketing the entire surface of the liquid only a small space is left into which the liquid may evaporate, and the danger of concentration of vapours within the open top above the roof is considered negligible. In minimising evaporation, this roof concurrently reduces the fire hazard.

R. A. E.

See also Abstract Nos. 365, 382.

Class 500. Properties and Their Determination.

330. Utility of Graphical Charts in Design and Operation (Part I.). C. M. Johnson. *Refiner*, 1933, **12**, 62.—Using data published in Bureau of Standards Misc. Publ. No. 97, rectangular co-ordinate and alignment charts are presented for: (*a*) the specific heat of petroleum oils and vapours; (*b*) the latent heat of vaporisation of petroleum oils of various gravities; (*c*) the specific volumes of petroleum products completely vaporised at atmospheric pressure. B. C. A.

331. Relationship Between End Point and True Boiling Point. A. J. Good and A. J. Connell. *Refiner*, 1933, **12**, 56.—Subsequent to 1925 a number of "true boiling point" columns have been devised handling materials with boiling points up to 500° F., though the most useful application is in the range of gasolines and naphthas. The use of such equipment and testing the products by A.S.T.M. distillation has brought to light the fact that when a cut is made up to a vapour temperature of, say, 450° F., the End point of the distillate produced is always below the cut point, but that, when a cut is made at 300° F., the reverse holds. A curve is given showing the relationship between A.S.T.M. end point ° F. and cut point ° F., obtained with various materials. Some values are as follows in the order given: 262,243, 300,284, 340,331, 380,380, 400,408, 430,450.

The end points of gasoline below the cut point may be explained as the cumulative effect of incorrect temperatures due to the fact that a thermometer calibrated for total immersion but only partially immersed is used in the A.S.T.M. distillation, and the loss of higher boiling materials during this distillation.

For the investigation of the phenomenon of end point being higher than cut point, samples of commercially pure compounds ranging from carbon tetrachloride to aniline were redistilled in the column under heavy reflux and a middle cut taken for A.S.T.M. distillation. The maximum temperature reached by low boiling compounds is about 310° F., and is relatively independent of the actual boiling point of the compound. At about 310° F. the radiation from the bulb to the neck of the flask apparently balances the radiation received from the bottom of the flask. The time from the 95% point to reach the maximum varies from a maximum of 30 minutes with carbon tetrachloride to a minimum of 3 minutes for aniline.

For the higher boiling compounds tested—viz., butyric acid and aniline—the end point is still above the cut point but by a smaller amount. The time required to reach the end point is within the limit of 5 minutes from 95% as stipulated in the A.S.T.M. procedure. In this range, superheating of the vapours is a probable cause of the elevated end point. The effect is quite different from that observed with low boiling compounds, where the rise in temperature continued long after the flask was dry.

It is concluded that the A.S.T.M. end point of low boiling material is higher than the true end point, and that the effectiveness of separation, as judged by A.S.T.M. analysis of successive cuts, varies with the temperature of the cuts, indicating poor separation with low boiling cuts and good separation between high boiling cuts. B. C. A.

332. Evaluation of Extreme Pressure Lubricants by Timken Tester. A. P. Frame and A. K. Graham. *Oil and Gas J.*, 5.1.33, **31** (33), 14.—In the operation of reducing gears, in addition to rolling contact between the teeth in mesh, there is also a rubbing contact where a point on a tooth in one gear

slides over the surface of the tooth in the other gear. The rubbing action causes the teeth to wear and is the major cause of gear failure. The rubbing speed is variable, being at a maximum at the initial point of contact, dropping to zero as the pitch circles of the two gears coincide, and increasing to a maximum again as the contact is broken. The rubbing speed may reach 900 ft./min., although normally it does not exceed 500 ft./min. The area of contact is infinitesimal, so that a lubricant of infinite load-carrying capacity would be required to maintain a lubricant at the line of initial contact. Actually, therefore, the lubricant film is ruptured and metal-to-metal contact takes place. This causes rapid wear and the formation of an area of contact rather than an initial contact line, and there is a tendency for the lubricant to reform its film as soon as sufficient area has been established to provide equilibrium conditions for the lubricant and rubbing speed involved. Therefore the higher the load-carrying capacity of the lubricant the smaller the wear before equilibrium conditions are reached. The load-carrying capacity of lubricants should therefore be determined at various rubbing speeds, starting with infinite load and finding the maximum load at which the lubricant will reform its film. The necessity for using an oil of correct viscosity is pointed out. The abrasive characteristics of the lubricant must also be determined. A Timken lubricant tester with certain modifications has been used in making these determinations. A description of the tester and of the method of operation is given. The authors have installed a motor-driven speed reducer which, at the beginning of the test, suspends the entire load free from the load lever, and, when started, transfers the load at a uniform rate to the load lever by means of a spring. This avoids bringing the machine from rest to full speed almost instantaneously, a procedure which is not in line with service conditions and which is a cause of erratic results. The new method of test is fully described, and reasons given for the adoption of certain of the conditions. After the test is completed, the scar on the test block is examined for scuffing. If this is absent, the area of scar is accurately determined and the load-carrying capacity of the lubricant in lb./sq. in. calculated from a knowledge of the load applied. The tests are repeated with increasing load until scuffing is visible, and the maximum load-carrying capacity of the lubricant is reported as the highest load in lb./sq. in. below the point at which scuffing occurs. Typical results are graphed and other curves are given, showing the maximum load-carrying capacity of three lubricants in lb./sq. in. plotted against rubbing speed in ft./min. Using the modifications indicated, the authors have been able to check results within 10%, the majority of results being considerably closer. Comparative abrasion characteristics are determined by making two runs of 10 mins. and 6 hrs. 10 mins. duration respectively, using the same lever load in each case, but new rings and blocks, and comparing the width of the two scars on the test blocks. Generally speaking, lighter lubricants are more abrasive than heavier ones of similar film strength, and lubricants containing free sulphur, talc, etc., give high abrasive readings by this method.

R. A. E.

333. Experiments with the New Tehar Viscometer. T. Ruemele. *Petr. Zeit.*, 15.2.33, **29** (7). *Motorenbetrieb*, **6** (2), 4–6.—Two types of viscometers are described. A is a modified form of an Ostwald glass viscometer, and consists of two reservoirs calibrated in c.c., each connected by means of a glass tap and ground glass stopper to a U-tube, the bottom of which is connected to a bulb fitted with an air-tube for the application of pressure. This arrangement forms one limb of a U-tube viscometer, the other limb containing the capillary and upper reservoir bulb. This bulb is also connected by a ground glass joint to a filling tube and cock. The two reservoirs may be filled with different

oils, so that using the air-pressure tube for cleaning purposes, the viscosities of the samples may be determined one after the other. A tap is provided at the bottom of the viscometer for the removal of the sample. The viscosity is measured in the normal way by taking the time required for the liquid level to pass from one mark on the capillary side of the U-tube to the other. The advantages claimed are the easy cleaning of the apparatus and its speed in use. The B type is more suitable for research work, and has only one filling reservoir, which is connected by a ground-glass joint to the capillary side of the U-tube so that the capillaries may be easily changed. The instrument is calibrated in ° E and viscosity determinations have been made for turbine and motor oils. The results are tabulated and the viscosities in ° E plotted against time in seconds, deviations from the average value being very small. Viscosities of diluted oils using toluene as a diluent have been determined, and the value of x in Tausz' formula η^x (undiluted oil) = η diluted oil can be found using this viscometer. W. S. E. C.

334. Laboratory Tests on Bitumen Road Coatings. von Skopnik. *Bitumen*, 1933, **3**, 21-22.—A very short account is given of the importance of certain tests in the examination of solid coatings. These include the determination of grain-size of the mineral matter, void estimation (then comparing the theoretical amount of bitumen with that found by extraction), softening point of the extracted bitumen, volume-weight of the coating, the effect of the penetration plunger (D.I.N. Test)—giving an indication of the impressions made by traffic and finally water absorption. C. C.

335. Significance of Flash-Points of Lubricating Oils. S. Erk. *Erdöl u. Teer*, 1933, **9**, 122-123.—The flash-point is not an inherent property of an oil, but depends largely on the method and apparatus of determination. The D.V.M. have standardised the Marcusson apparatus for this purpose.

The flash-point of an oil has little precise significance. It is often regarded as being a measure of the fire-risk associated with an oil, but this depends so much on the conditions of use.

In evaluating an oil, flash-point must be taken in conjunction with many other properties. It is useful to the specialist in helping to indicate the source and nature of an oil. E. B. E.

336. Influence of Hydrocarbons on Illuminating Power of Lamp Oils. N. Danaila. *Petr. Zeit.*, 15.2.33, **29** (7), 1–5.—This article is an answer to Grote and Hundsdörfer's query as to whether aromatic hydrocarbons decrease the illuminating power of burning oils in general and in particular of Rumanian and Galician burning oils. In order to confirm the author's two chief conclusions that the candle-power is greater the less the aromatic content, and, moreover, that a kerosine containing no aromatic hydrocarbons has the maximum candle power, the quantity of these aromatics was determined in five Rumanian burning oils representing three types of kerosines obtained from Arbanei, Campina, Baicoi, Moreni and Bustenari crude oils, and in the same kerosines after removal of aromatic hydrocarbons with 98·33% sulphuric acid. The same lamp and same procedure as in the previous work was used in order to make the results comparable. It was found that the unrefined kerosines containing aromatic constituents had a greater candle power than the corresponding aromatic-free hydrocarbons. Synthetic kerosines were then prepared by adding aromatic constituents extracted from the kerosines in amounts of 5, 10, 20, 30, 40 and 50%, to the aromatic-free kerosines and the candle-powers again determined. Danaila concluded that all kerosines containing a definite quantity of aromatic hydrocarbons had a greater candle power than the corresponding aromatic-free

burning oils, and that the candle-power of the synthetic kerosine increased with the content of aromatic hydrocarbons to a maximum value beyond which it decreased. Regarding refining methods, those which did not remove at all or only slightly the aromatic constituents produced kerosines possessing greater candle powers than the corresponding crude kerosines. The best processes to adopt are those in which the deleterious tarry constituents are removed, the aromatic hydrocarbons remaining unattacked. Danaila contends that although refining removes some aromatic constituents which increase the candle-power of oils derived from the same crude, a refining method is essential in order to remove tarry, sulphur and nitrogen compounds present in the crude kerosine. When the kerosine has a low candle-power, it is considered to be due to a large quantity of tarry substances or to its use in an unsuitable lamp rather than to an insufficient quantity of aromatic hydrocarbons. Danaila also maintains that it is quite impossible to compare results obtained by burning the same kerosine in two lamps of different construction. W. S. E. C.

337. Some Refinery Technologists Object to Adopting C.F.R. Motor Method. R. C. Conine. *Oil and Gas J.*, 2.2.33, **31** (37), 26.—Certain technologists do not favour the adoption of the C.F.R. motor method on the grounds that the method is unduly discriminating against cracked gasolines. Some comparative tests carried out by the research and motor methods respectively gave the following octane numbers: E. Texas, straight run, 62 and 58·5; E. Texas liquid phase cracked, 65 and 60; E. Texas vapour phase cracked, 80 and 71; blend of Healdton straight run and liquid phase cracked, 65·5 and 61·2; blend of Seminole straight run and liquid phase cracked, 65·8 and 61·2; blend of Mid-Continent straight run and vapour phase cracked, 67·6 and 61·5; blend of Mid-Continent straight run and liquid phase cracked, 69·5 and 63·3. Ethylized gasolines showed comparatively little depreciation when tested by the motor method as compared with research method ratings. Some objection is raised to the sub-standard reference fuels A—2 and C—6 on the grounds that it has not been established that they have suitable physical properties in respect to carburetion characteristics. It is also stated that the results obtained with certain of the cars used in the road tests, carried out in connection with the development of the motor method, reflect rather on the combustion characteristics of the engines than on the value of cracked gasolines. It is further stated that only 66 out of the 285 fuel tests fell within 5%, plus or minus, of the average line setting, that 114 showed an actual road performance better than the calculated rating and 33 were below the average, whilst data were missing on 42 fuel tests. R. A. E.

338. Effect of an Electric Field on the Flame Temperature of Combustible Gas Mixtures. B. Lewis and C. D. Kreutz. *J. A.C.S.*, 1933, **55**, 734.—The effect of an electric field applied transversely across a flame, on the flame temperatures of rich, lean and nearly theoretical mixtures of natural gas, ethylene, isobutane and butylene in air has been investigated, using the sodium line reversal method for measurement of flame temperatures. The effect of the field was to reduce the flame temperature, the reduction being greatest for low gas velocities and for largest flame length exposed to the field before observations were made. The greatest effect was found for lean mixtures and the smallest for rich mixtures (*e.g.*, for ethylene: lean—116°, rich—12°). It has also been shown that a low temperature flame of CS_2 vapour is unaffected by an electric field, but that a high-temperature flame of the same material is deflected towards the negative electrode, as are the flames of other combustibles. W. H. T.

339. Sulphur Compounds Derived from Petroleum. P. J. Wiezevich, L. B. Turner and P. K. Frolich. *Ind. Eng. Chem.*, 1933, **25**, 295–6.—The following aliphatic mercaptans, methyl, ethyl, normal and iso- propyl, secondary butyl, normal and secondary amyl mercaptans are obtained during the recovery of spent caustic soda used in treating crude petroleums. These can be converted into thioethers, disulphides and other sulphur compounds which are of commercial value.

Ethyl mercaptan is converted under the influence of a catalyst, viz., cadmium sulphide-zinc sulphide-alumina at 350° C. into ethyl thioether; when the mercaptan from petroleum is used a preliminary refining with active charcoal and then distillation to remove heavy ends is necessary first. Methyl and ethyl thioethers dissolve cellulose nitrate in the presence of ethanol, and propyl ether dissolves cellulose nitrate when mixed with methanol. The three thioethers also dissolve rubber, and they are solvents for some resins—*e.g.*, petroleum resin, p-coumarone, abietic acid, for Grignard reagents and as initial materials in the preparation of sulphonium compounds.

Ethyl disulphide is produced in 90% yield by decomposing ethyl mercaptan at 100° C. in the presence of iron, copper, iron sulphide, charcoal. The disulphide is a good solvent for rubber and for certain resins.

Ethyl thioether when treated with hydrogen peroxide in glacial acetic acid and cooled yields ethyl sulphoxide, which is used as a plasticiser for pyroxylin and diethyl sulphone is formed without cooling.

The action of sulphur chloride in a solution of carbon disulphide on ethyl mercaptan produces polysulphides. Oxidation of ethyl mercaptan with potassium permanganate gives ethyl sulphonic acid and sulphonates which are used commercially as wetting agents and demulsifiers. W. S. E. C.

340. Analysis and Standardisation of "Carbolineums." L. A. Deshusses and J. Deshusses. *Helv. Chim. Acta.*, **15**, No. 5, 1030–1048. (From *Erdöl u. Teer*, 1933, **9**, 108.)—"Crude" carbolineum is a complex mixture of hydrocarbons, phenols and organic bases; the hydrocarbons may be aliphatic or cyclic and partially hydrogenated or chlorinated. The material is used for wood-impregnating. "Soluble" carbolineum is prepared by emulsifying the carbolineum in an alkaline or neutral medium and is used as an insecticide. On dilution an emulsion of water in oil is formed, but on further dilution this reverses to an emulsion of oil in water.

The authors discuss the use of the emulsions and the analysis of the products. Phenols are estimated by extracting the ether solution of carbolineum with 1·7% sodium hydroxide with the addition of a little common salt. Bases are removed with 4% sulphuric acid. The remaining hydrocarbons may be separated by fractional distillation, and the aliphatic and aromatic constituents separated by means of concentrated sulphuric acid or dimethyl sulphate. Water is estimated by distillation with toluole. If chlorinated hydrocarbons are present, special care must be taken as the alkaline emulsifier hydrolyses the chlorine compounds and leads to pronounced frothing. Trouble may be caused by the presence of fatty, naphthenic or resin acids. These are best removed by conversion into the sparingly soluble barium salts.

From the results of numerous analyses the limits of experimental error are worked out. The physical constants recorded include specific gravity at 20°, viscosity at 20°, flash-point and boiling-range.

From biological tests the authors find the hydrocarbon fractions distilling between 250° and 270° are the least injurious to plants and have the highest insecticidal power.

Consideration is also given to the various specifications in use and recommendations as to the composition and stability of these products. A 10 to

15% solution in distilled water should remain stable for 72 hours, no solid material should be present nor separate on cooling to 5 to 10° C. At least 75% of oil and at most 10% water should be present in a soluble carbolineum. Maxima of 15% phenols and 5% bases are allowed. Up to 25% brown coal-tar or 10% mineral-oil may be added. 50% of the oil should boil above 250°, for anthracene oil products or 80% over 200° for middle-oil products. E. B. E.

341. Polymerisation of Some Unsaturated Hydrocarbons: Catalytic Action of Aluminium Chloride. W. H. Hunter and R. V. Yohe. *J. A.C.S.*, 1933, **55**, 1248–1252.—Aluminium chloride forms complex compounds with acetylene, ethylene and isobutylene which lead to the formation of olefinic compounds. The use of these complex compounds as polymerising agents is discussed, and a theory is advanced for the polymerisation based on the electronic structures of aluminium chloride and olefins. The activated olefinic bond being represented as $>C:\ddot{C}<$ a molecule of aluminium chloride could accept a "free" electron pair to give an activated complex in which one of these carbon atoms would be momentarily three covalent. This complex would be a good catalyst for polymerisation, since it would combine at once with another molecule of olefin by virtue of the highly unsaturated nature of the carbon atom containing only six electrons in its outer shell. This new complex of higher hydrocarbon content is still activated, and can therefore react with another molecule as before. The carbon chains increase in length depending on the heat of the reaction and the ability of the co-ordinate bond to maintain this combination and the possibility of ring formation. W. S. E. C.

342. Hydrogenation: Cracking of Naphthalene. C. C. Hall. *Fuel*, 1933, **12**, 76.—Under conditions of high hydrogen pressure, but in the absence of added catalysts, naphthalene remains unchanged at temperatures below 450° C. Above this temperature, incomplete reaction takes place with the production of tetralin and low-boiling hydrocarbons. In the presence of a catalyst consisting of active charcoal impregnated with ammonium molybdate, conversion of naphthalene to tetralin is appreciable at 350° C., increasing to a maximum at 400° C. with reaction time of 2 hours. Optimum conditions are 7% of hydrogen at 100 atm. Heating beyond 400° C. results in the production of low-boiling hydrocarbons by cracking of the tetralin—*e.g.*, 50% of hydrocarbons distilling below 160° C. are produced at a reaction temperature of 500° C. Above this, however, the reaction product contains more unchanged naphthalene than at the lower temperatures. Increase in time of heating at 450° C. increases the yield of low-boiling hydrocarbons without affecting the naphthalene-tetralin equilibrium. The use of sulphur, together with the molybdenum catalyst, leads to an increased rate of hydrogenation. The decomposition of the tetralin, which takes place at above 400° C. proceeds: tetralin⟶*n*-butyl benzene⟶ethyl benzene⟶toluene⟶benzene, and does not involve the formation of o-xylene. Decahydronaphthalene which is produced in small amounts is stable below 400° C., but is decomposed at higher temperatures with the production of cyclo-paraffins and gaseous hydrocarbons of the paraffin series. The catalyst does not affect the rate or the course of the decomposition reactions but functions solely as a hydrogenating catalyst. W. H. T.

343. Reaction of Free Ethyl Radicals from the Thermal Decomposition of Tetraethyl lead. R. N. Meinert. *J. A.C.S.*, 1933, **55** (3), 979–989.—In this work an attempt is made to determine how free ethyl radicals split off from lead tetraethyl and react with each other by a study of the reaction products.

The experiments were carried out under varied conditions. Liquid tetraethyl lead was decomposed at its boiling point by the flow method used at atmospheric and at low pressures and the static method used at several temperatures and pressures and in the presence of nitrogen and of Pyrex glass packing. Four reactions are involved, illustrated by the following equations: (1) $C_2H_5 + [H] \rightarrow C_2H_6$; (2) $2C_2H_5 \rightarrow C_4H_{10}$; (3) $2C_2H_5 \rightarrow 2C_2H_4 + H_2$ and (4) $2C_2H_5 \rightarrow C_2H_6 + C_2H_4$. The mechanism of the reactions is as follows: First, under high concentration of the lead tetraethyl radicals and low concentration of the ethyl groups hydrogen is extracted from the lead tetraethyl molecule by an ethyl radical ethane; second, two ethyl groups combine to form butane; third, two ethyl groups react to form ethylene and hydrogen, and fourth, two ethyl radicals react to give one molecule of ethane and one molecule of ethylene. Reaction (2) is a wall reaction or three-body collision, and (4) occurs mainly in the gas phase and to a less extent than the others since most of the ethane is accounted for by reaction (1), and most of the ethylene by reaction (3). The best conditions for reaction (4) are a high concentration of the lead tetraethyl radicals and a slow velocity of decomposition, when there is a greater chance of an ethyl group colliding with a molecule of lead tetraethyl than with another ethyl radical.

W. S. E. C.

344. Higher Aliphatic Sulphonic Acids. C. R. Noller and J. J. Gordon. *J. A.C.S.*, 1933, **55** (3), 1090–1094.—A method for preparing aliphatic sulphonic acids containing from 9 to 14 carbon atoms is described, in which the lead mercaptide is oxidised with nitric acid. The corresponding alcohol is used as the starting material in all cases, and benzylaniline salts of the sulphonic acids are obtained as derivatives. The general properties of the acids are tabulated. W. S. E. C.

345. Examination of Binary Liquid Mixtures. W. A. Wright. *J. Phys. Chem.*, 1933, **37**, 233.—Stress is placed on the necessity for amassing data on pressure-temperature-composition equilibria in connection with the study of liquid mixtures, and an apparatus and procedure for the purpose are described. An examination of the system, toluene-ethyl alcohol has been made over a pressure range of 700 mm. and its attendant temperature changes. From the data obtained generalisations have been made on the laws of liquid mixtures, permitting equilibria predictions and calculations such as the heat of vaporisation or the partial heats of vaporisation at any point. The generalisations have been tested against published data and their value confirmed. W. H. T.

346. Modifications of the Engler Viscometer. L. Ubbelohde. *Erdöl u. Teer*, 1933, **9**, 123–124.—The author describes two modifications which he has made to the Engler viscometer with the object of increasing the ease of manipulation and of rendering the instrument suitable for the examination of viscous liquids such as tars and asphalts.

In using the customary Engler apparatus much time is spent in adjusting the surface of the liquid to the three levelling points; there is no device for removing excess liquid. The author overcomes this difficulty by using a hollow tube instead of the customary rod used to lift the ball-valve. The tube has an overflow-hole suitably situated at the surface of the liquid. Excess oil overflows through this and escapes through the tube (the ball is also bored) and out through the jet. The adjustment of the viscometer is not so critical with this device as with the levelling points. For calibrating the instrument with water, the ordinary valve must be used as the over-

flow device does not work properly with water after having been in contact with oil. The device is illustrated.

The second modification consists in constructing the ordinary Engler jet, which is about 2·9 to 2·8 mm. wide, so that it may be screwed out and replaced by a similar fitting with a jet 5 mm. wide. This is more suitable for the measurement of very viscous liquids, as the time of outflow is only about one-tenth of that for the standard jet. The alternative jet may be calibrated against the normal jet, using an oil of at least 30° Engler viscosity. Using the factor thus obtained and the conversion tables for the Engler viscometer, the viscosities of asphalts may thus readily be obtained in terms of Engler, Saybolt or Redwood units or kinematic viscosity. E. B. E.

347. Colour in Gasoline has Complex Nature. G. W. Trusty. *Refiner*, 1933, **12**, 53.—The few coloured hydrocarbons that are known contain conjugated unsaturated groups, as in the fulvene series. The fulvenes range from a yellow to an orange colour. Gray and Dronjin state that pure hydrocarbons are colourless, but become coloured on oxidation. Leuco bases, whilst colourless themselves, yield colour bases upon the addition of a single atom of oxygen. This colour base is also colourless, but has the power to unite with certain other elements or groups to give coloured compounds. Again, colour may be due to groups known as chromophores. The chromophores (so termed by Witt) unite with other groups to form larger groups known as chromogens. These chromogens may be coloured or not; if colourless, they may unite with other groups known as auxochromes, *e.g.*, NH_2 and ON, which impart colour to the molecules and the power to form coloured salts.

All petroleum products are acted upon, even at ordinary temperatures by the oxygen of the air, becoming yellow and turbid, depositing flocking precipitates and acquiring an acid reaction. Weger has shown that pure saturated paraffin hydrocarbons are oxidised by the oxygen of the air in sunlight. Part of the substances formed when kerosine is exposed to sunlight is believed to be asphaltogenic acids. Brooks and Humphrey have shown that oxidation is greatly accelerated by the presence of sulphur-containing compounds. Oxidation is accelerated and may even be initiated by sunlight. Temperature also accelerates oxidation.

The principal cause for the yellow colour developed by gasoline is probably polymerisation of unsaturated hydrocarbons.

The stabilisation of gasoline by inhibitors has proved effective with some gasolines, but not with others under the same conditions. Some of the compounds which have proved successful are anthracene, Du Pont No. 2, gum, camphor, phenanthrene, pseudocumene, acenapthene, fluorene, naphthol, tetralin, pthalimide, urea and naphthalene.

The effects of vapour-phase clay treatment, the zinc chloride process, acid treatment, followed by rerunning or contacting with clay, are indicated. B. C. A.

348. Industrial Application of the Ultra Violet Radiation Test. III. Lubricating Oils and Greases. J. Muir. *Ind. Chem.*, 1932, **8**, 437–438.—The author describes three methods of application of the ultra violet ray test to lubricating oils and greases:—(1) *Film method.* A standard thickness of film on a microscope glass is examined at a given distance under a chemist's analytic lamp, using a plate of non-fluorescent porcelain or quartz as the blank for means of comparison; (2) *Absorption method.* Grease or oil is absorbed on non-fluorescent filter paper of uniform size. Impregnation and freedom from excess of material under examination is important; (3) *Solvent method.* Dispersion or solution in a solvent gives a means of comparison of some oils or fats which do not fluoresce in the natural form.

It cannot be assumed that identical results are obtainable from one specimen using the three methods of examination. The fact of fluorescence does not necessarily identify an oil of a group of oils though the nature and colour of the fluorescence is indicative. Three tables of comparison of various lubricating oils are appended in which the film method has been applied. It is also claimed that ready distinction between a "gumming" and "non-gumming" lubricating oil is obtained. Thus on long exposure to air a thin film of "gumming" lubricating oil will give a greenish and eventually a yellowish appearance, whereas the "non-gumming lubricating oil" retains its original appearance. The author suggests, also, that probably the variation in the fluorescent appearances of greases bears some relation to the amount of saponified material present. A short description of a convenient and satisfactory form of ultra-violet radiation apparatus known as the Callophane is given. R. E. D.

349. Analysis of Ozokerite by the Retention Effect. Anon. *Matt. Grasses*, 15.11.32 (295), 9664 (from *Chem. Techn. Fabrikant*).—Waxes, in the form of a paste with solvents, lower the rate of evaporation of the solvent, the magnitude of such lowering being dependent on the characteristics of the wax. This arresting of the evaporation rate by the waxes is denoted by the term "retention" (R). The inverse value is represented by a quantity that is easily determined by experiment and is defined by the term "index of retention" (I.R.), which is the loss in weight determined under standard experimental conditions of a solution or paste of wax in the solvent, cooled under standard conditions. It is expressed as a percentage:—

$$R = \frac{1}{I.R.} \text{ or } \frac{100}{I.R.}.$$

Many waxes, such as ozokerite and beeswax, have the property of lowering the I.R. very considerably, even when present in small quantities in other waxes, such as paraffin. With certain proportions, *e.g.*, 98% paraffin 50/52° C. m.p.; 2% refined ozokerite, the I.R. falls to a sharply defined minimum. If this property is defined as "the retention effect" (E.R.), a numerical value is obtain by the following formula:—

$$E.R. = \frac{I.R. - I.R.\ minimum}{O\ M.}$$

where I.R.=determined index of retention; I.R. min.=minimum obtained with the paraffin mixtures; O M=percentage of ozokerite in the mixture giving I.R. min. The more the E.R. is raised the better is the quality of the ozokerite. All possible mixtures of ozokerite and paraffin give I.R.'s below those of the constituents.

The method is specially convenient in the analysis of ceresin and refined ozokerite. Other methods at present used give little information regarding these materials. The method described permits the evaluation of the ozokerite in terms of the "retention effect" described. S. T. M.

350. Composition of the Fractions of Primary and High Temperature Tar. E. B. Kester and W. D. Pohle. *U.S. Bur Mines Repts. Invest.* 3197. Nov., 1932.—A summary of previous investigations on this subject is first given, with observations on the differences between primary and high temperature tar. Thus the percentage of aromatics, particularly naphthalene and anthracene, are greater in the latter, with negligible amounts of paraffins and naphthenes and a lower percentage of higher phenols. The authors have endeavoured to gain information on the net results of pyrolysis of primary

products of coal decomposition and have made a strict comparison of a high temperature and a primary tar of common origin.

Coal from Taggart bed, Rada, West Country, Va., was used, and the primary tar was obtained by carbonisation of 20 lb. charges at 500° C. in a rotary retort. High temperature tar was prepared from the same coal by carbonisation of 80 lb. charges in a stationary cylindrical retort. Analysis of these corresponding tars brought to light the following facts: (1) Acids are in greatest concentration in the 170°–230° fraction of both tars, but the difference from fraction to fraction is most noticeable in the high temperature tar. Higher phenols appear only in small quantities in the high temperature tar. (2) In the high temperature tar, the neutral oil is lower, naphthalene and anthracene are present to a marked degree, olefins and aromatics are much the same, and paraffins and naphthenes have almost disappeared. (3) Aromatics are present in greatest percentage in the higher boiling fractions of both tars. (4) Paraffin hydrocarbons in both tars tend to decrease in percentage as the distillation temperature rises. It is made clear that both distillate and pitch are reduced in volume at the higher temperature of carbonisation and also that a greater yield per degree rise in temperature is apparent in the high temperature tar distillate fraction 170°–230°, which is in accordance with the large quantities of naphthalenes and phenols found in this cut. The constituents of the corresponding low and high temperature tars in the order of increasing stability to pyrolysis are: (1) paraffins and naphthenes, (2) acids, (3) neutral oil, (4) aromatics, (5) olefines, (6) pitch. A table of comparison between low and high temperature tars from ten separate coals is appended.

A summary of the views of various workers is given on the subject of source of compounds in high temperature tar, but the writers have shown that aromatic hydrocarbons as a major class of compound do exist in low temperature tar, and it is postulated that these are the parent substances of the aromatic hydrocarbons in high temperature tar. R. E. D.

351. Patents on Analysis and Testing. E. H. Payne. U.S.P. 1,899,916, 28.2.33.—Apparatus for distilling heavy lubricating oils without cracking and entrainment. A helical trough is placed in thermal contact with and around the column and has a flat bottom so that oil will flow thereon in a relatively thin film. W. H. T.

See also Abstract No. 384.

Class 600. Refining and Refineries.

352. Use of Lime in the Removal of Hydrogen Sulphide. Anon. *Refiner*, 1933, **12**, 50.—The crude oil produced in the Garber Field, N. Oklahoma, when processed by straight skimming or cracking, is non-corrosive. The reforming of a charging stock, 300° F. I.B.P. and 500° F. F.B.P., secured by straight distillation, led to corrosive effects showing up in the vapour recovery plant, especially the absorber. The temperature in the reforming tubes was about 1010° F., breaking down the sulphur content into hydrogen sulphide.

A deposit of iron sulphide with a red cast was produced in the absorber of the recovery plant, but the condenser piping and vapour lines were free.

It was found that the vapours could be freed of hydrogen sulphide by passage through a mist of saturated lime water, and a vapour scrubber was fabricated by inserting wood baffles in an old clay tower. Hydrated lime at $15·01 per ton is used in preparing the treating solution and is circulated by centrifugal pump. The treatment cost amounts to 50 cents per 1000 brls.

of gasoline produced in the recovery plant. The lime water treatment has also resulted in the recovery gasoline being stabilised in colour to time and light, whereas previously it was very unstable, seriously affecting its blends with the refinery products. B. C. A.

353. Heat Flow Diagram of a Two Stage Distilling Plant. G. Vandenburg. *Refiner*, 1933, **12**, 47.—In a two stage distilling unit the heat balance may be written in the form $F_1+F_2+\text{steam}=S_1+S_2+W_1+W_2$ where the quantities on the left hand side represent the heat input to the furnaces and of the incoming steam, whilst S_1 and S_2 are the heat contents of the stack gases and W_1, W_2 of the cooling water.

A consideration of this equation leads to the conclusion that the less cooling water the installation requires, the less fuel will be consumed, and the less loss of heat through the smoke stack.

Calculations are given, based on Publ. No. 97 of the Bureau of Standards, "Thermal Properties of Petroleum Products," for the heat input and output of the atmospheric and vacuum pipe stills and fractionators of a 15,000 brl. per day plant. The heat balance for the flashing tower taking 9% bottoms from the vacuum tower is also given. B. C. A.

354. Computation of Distillation Apparatus for Hydrocarbon Mixtures. E. W. Thiele and R. L. Geddes. *Ind. Eng. Chem.*, 1933, **25**, 289.—A method of computation is given for the solution of column problems involving complex mixtures obeying Raoult's law or some simple modification thereof. The following assumptions are made: (*a*) a constant plate efficiency for all components (finite or infinite); (*b*) the number of theoretical plates, and (*c*) the heat input, tentatively assuming the temperature on each plate. The concentration of each constituent in the vapour in equilibrium with a liquid can therefore be calculated, if the concentration of that constituent in the liquid is known, or vice versa. It is shown that material balance equations can be used to find the ratios of the concentrations of the constituents in the overhead and bottoms. These combined with the known concentrations in the feed (given by true b.p. analysis) are sufficient to fix the values of the concentration of each constituent in each liquid and vapour up and down the column, but the sum of these concentrations will not equal unity unless the tentative plate temperatures assumed have been correct. The method is extended to cases in which side streams are drawn from the column or the feed is admitted at two or more points. W. H. T.

355. Dubbs Unit with Two Heaters Cracks Wide Range of Charging Stocks. W. T. Ziegenhain. *Oil and Gas J.*, 19.1.33, **31** (35), 22.—At a Houston, Texas, refinery the use of dual furnaces in a newly completed Dubbs cracking unit gives ideal conditions for processing a wide range of charging stocks, while a unique arrangement utilises excess heat to re-run the pressure distillate made on six other Dubbs units operating in the refinery.

The unit can handle Refugio crude, 24° A.P.I. residue from East Texas crude, P.D. bottoms gas oil, 48° A.P.I. str. run naphtha and 52° A.P.I. P.Dist. as charging stock.

The method of operation of the unit handling 9000/10,000 brl. of raw 52° A.P.I. P.Dist. made on the six other units, plus 2000/2800 brls. of E.Pt. str. run naphtha per day, is discussed.

Pressure distillate is charged through a vapour heat exchanger into a fractionating tower. The P.Dist. bottoms are passed through a heat exchanger into the cracking coils, where they are further cracked, the tops going into the fractionating tower and the residue being drawn off. The second furnace is charged with straight run naphtha of boiling range between 280° F. and

400/480° F., together with a light distillate fraction taken off as a side stream from the fractionating tower.

The furnaces employed are gas fired Alcorn type radiant heat furnaces equipped with floor tubes.

The yields from cracking P.Dist. bottoms are believed to be 50% of 400° E.Pt. benzine of 72 octane number (untreated) and that from cracking naphtha 80/85% of 400° E.Pt. gasoline of 78/80° octane number, 15% of 6 gravity fuel oil and a gas production of 300/350 cu. ft. per brl. The gas contains 3–5 galls. of 30 lb. vapour pressure natural gasoline per 1000 cu. ft., which is recovered in the vapour recovery plant.

It is believed that runs of 60 days can be realised as a routine operation when running these light distillates. C. L. G.

356. Experiments on the Low Temperature Carbonisation of Bayac Lignite. V. Charrin. *Matt. Grasses*, 15–11.32 (295), 9674–75.—A disadvantage of this particular lignite is that it crumbles readily in air. For this, and commercial and distribution difficulties, low temperature carbonisation of the lignite has been investigated. An average analysis of the lignite gives the following results :—Moisture, 21·5%; ash, 12·50%; volatile matter, 36·50%; fixed carbon, 30%; sulphur, 3·21%; sp. gr., 1·33; cal. value, 4000 cals. An average distillation gives :—Water, 30·50%; oil, 14·2%; semi-coke, 45·30%; gas, 9·8%; benzole from gas, 0·80%; loss 0·3%. The semi-coke contains 1·92% of S; sp. gr. 1·110; cal. value, 6136; and gives on further analysis :—Moisture, nil; ash, 26·80%; volatile matter, 6·50%; fixed carbon, 66·70%. 14·20% of primary tar and pitch, of sp. gr. 0·960 and solidifying at 20° C., is obtained. On fractional distillation this yields :—0–100° C., 18·5%; 100–160° C., 11·0%; 160–240° C., 18·5%; 240–280° C., 22·0%; 280–340° C., 4·0%; residue, 26·0%. The heavy oils contain 27% of phenols and acids. The pitch gives 70% volatile matter and 30% coke. It pulverises readily, is of good quality and ductility, softens at 50–60° C., melts at 110° C., and solidifies at 44° C. The coke can be satisfactorily briquetted. S. T. M.

357. Diatomaceous Earth. R. Brady. *Petr. Eng.*, Feb., 1933, **4** (5), 35.—The origin, occurrence and preparation of diatomaceous earth, and its use as a filter aid in the Weir dewaxing process is discussed. Diatomaceous earth is a fossilised deposit of the remains of several hundred varieties of small plants, together with traces of scilia of small marine animals of a sponge-like structure. The organisms occur in a very wide variety of forms of microscopic size. The type found in commercial filter aid is the *Cosinodiscus perforatus*, a disk-shaped diatom of 0·005/0·030 in. in diameter and 0·0001/0·0006 in. in thickness, dotted with minute holes or depressions arranged in geometric form.

The diatomaceous earth is found in nearly all parts of the world in varying degrees of purity, but the nearly pure earth is only available in a few localities, most of which are in the U.S. It usually occurs under an overburden of 6 to 20 ft., which is uncovered, and the earth mined by hand or power shovels. In some cases sub-surface operations are necessary, but this is not usually economical in comparison with open cut quarrying. In Florida and Georgia, where the deposits are located under water or in swampy ground, hydraulic or dredging operations are necessary.

The first stage in the refining of diatomaceous earth is air drying, for which purpose the earth is quarried in slabs of convenient size usually 2 to 4 ft. square and 6 to 8 in. thick. The deposits occur with laminated structure running parallel to the strike of the bed, which facilitates the splitting of

the slabs. The blocks of earth are stacked so as to allow maximum circulation of air and dried for 6 to 8 weeks, thus reducing the moisture content from 50% to 8/10%; after drying, the slabs are run through a crusher and grinder, care being taken to separate the diatoms with a minimum of breakage. After grinding, the particles are graded by air separation. The diatomaceous earth used as filter aid is a white to pink coloured floury material, the particles being extremely fragile, very abrasive and a good adsorbent but poor absorbant. A typical analysis is H_2O, 5·25%, SiO_2, 89·05%, Al_2O_3, 4·10%, Fe_2O_3 0·60%, CaO 0·40%, MgO 0·4%, balance ·20%. The presence of particles of varying size greatly accelerates the rate of filtration, as compared with that when using a cake of uniform-sized particles.

In the operation of a Weir dewaxing plant the stock is diluted with an equal proportion of a solvent, usually naphtha, the solution chilled to low temperatures and filter aid added, using 20/50 lb. of filter aid per bl. of solution. After thorough mixing the slurry is filtered, the wax and oil remaining on the filter medium. The filtered solution is re-run to remove the naphtha, and the filter aid cake washed with naphtha and recycled continuously, the wax being recovered on distillation of the naphtha wash.

The major problems met with in filtering with diatomaceous earth are: (*a*) Its fragility. The breaking of the particles reduces its efficiency to 60% in a few weeks, this diminishing to a minimum of 50%. Progress has been made by the producing companies in the selection of diatoms of shapes and size calculated to have more rigidity, and by an after treatment consisting of fluxing a salt over the material to increase its strength. Breakdown can also be reduced by the refiner moving the material with as little stress as possible, *i.e.*, by using low speed centrifugal pumps and large pipelines and utilizing gravity fall in a vertical line when possible. The compression of the filter during operation also reduces the rate of filtering; (*b*) the presence of moisture in the earth. 3% of water will affect the filter rate considerably, as well as result in plugging of the lines with frozen agglomerates of filter particles. Moisture can also be derived from atmospheric leaks, moisture in solution or suspension in the oil naphtha mixture and the moisture in a new charge to the plant. Atmospheric moisture is practically excluded in a continuous pressure system as the air or inert gas used to create filtering pressure is recycled continuously through a calcium chloride or sulphuric acid drier. In continuous vacuum or batch pressure systems rapid accumulation of moisture occurs. Attempts to reduce this condition by driers have only been moderately successful. Storage of new filter aid in a warm dry place, coupled with careful drying of oil and naphtha will reduce the trouble due to the other two causes; (*c*) Abrasion of metal parts. The presence of 80%/90% of silica in the particles results in rapid abrasion of the metal parts. The use of high silicon iron, etc., where possible is useful in this direction. Improvements in the latest design of the Weir filter earth, scrapers, packing and soft metal parts of the filter unit have reduced the erosion met with in the conventional vacuum filter. C. L. G.

358. Studies in Auto-Oxidation: III. Initial Act in Auto-Oxidation. H. N. Stephens. *J. Phys. Chem.*, 1933, **37**, 209.—The author discusses in the light of recent publications whether the isolable peroxide is actually the primary addition product or whether a more active and unstable substance is first formed and subsequently converted into the isolable compound. The unshared or exposed electron theory is excluded on the grounds that vibrational activation appears to be quite sufficient to account for experimental facts, and that saturated hydrocarbons are auto-oxidised although possessing no molecular valence electrons. It is assumed, therefore, that auto-oxidation involves the primary addition of oxygen to a linkage which

has been activated by vibration, whether the necessary vibration level has been obtained purely by thermal means or by absorption of light. The application of the vibrational activation theory to ethenoid compounds, ethers, aldehydes and saturated hydrocarbons is dealt with. W. H. T.

359. Hydrofluoric Acid, a New Refining Agent. H. Lederer. *Erdöl u. Teer*, 1933, **9**, 107–8.—This article is a discussion of the properties and use of anhydrous hydrofluoric acid, which has recently been proposed as a refining agent for petroleum oils. The physical properties, according to Fredenhagen and Gadebusch, are given.

Hydrofluoric acid converts unsaturated hydrocarbons into insoluble polymers. On account of its very low boiling-point (19·4° C.) the refining agent is readily and completely removed from the oil. It is also easily liquefied. Moreover, it does not tend to destroy hydrocarbons.

Disadvantages are the high price compared with sulphuric acid. It cannot be used in open vessels on account of its high vapour-tension and poisonous nature. Treatment of the skin with a paste of glycerine and magnesia is recommended in case of burning with the acid. The preparation of the material is discussed.

Metallic chlorides such as those of zinc and iron catalyse the refining action. Examples of the effect of the treatment are given. E. B. E.

360. Water Treatment of Corrosive Refinery Gas. Anon. *Refiner*, 1933, **12**, 74.—Hydrogen sulphide has been eliminated from gas passing to the recompressor in an Oklahoma refinery by passage through water maintained at 110–115° F., and contained in an absorber, kept one-third full.

A constant circulation of warm water is effected by the introduction of hot water condensate from a re-run still provided with steam heating element in the base, and the surplus water is removed from the base of the absorber. 750,000 cu. ft. of gas per day pass through the absorber. B. C. A.

361. Improvement of the Odour of Unsaturated Light Oils. H. von Winkler. *Chem. Z.*, 14.12.32, p. 991.—The ordinary treatment of gasoline with sulphuric acid, caustic soda and plumbite, followed, usually by a redistillation, does not remove the yellowish tinge and the unpleasant onion-like odour of gasoline made from Estonian shale. This results very unfavourably to the adoption of the shale gasoline for household purposes, pocket lighters, etc. Even aviators and their passengers complain of the annoyance of the Estonian gasoline with its unpleasant odour. This is caused not only by the unsaturated compounds present, but also by variable sulphur compounds not easily removed completely. The unsaturated compounds form a dark yellow deposit, especially in storage. Under the influence of heat, air and light this becomes a thick yellow resin, which is a principal carrier of the odour. Stabilising by adding small quantities of hydroquinone or similar agent retards the resin formation but does not prevent it. If the usual method of treating, however, is supplemented by adding some methanol to the sulphuric acid, the malodorous fractions in the gasoline become water-soluble and are easily washed out. The gasoline becomes water-white and bright. The odour is no longer unpleasant or noticeable. Instead of methanol, other aldehydes or other suitable substances may be used if they form compounds with the gasoline that can be washed out. For example, adding 0·4% of 40% formalin and some 70% sulphuric acid will remove the odour from a previously refined gasoline. The crude gasoline requires only a little more. No new equipment is necessary.

The question of the improvement of the odour is important, because it is that which hinders the rise of the Estonian oil industry. The oil-shale deposits of Estonia are large enough to supply the motor-fuel needs of the

countries bordering on the east side of the Baltic Sea for more than 100 years. An advantage of the knock-resistant unsaturated gasoline is that with the correct nozzle adjustment it will give 123% as much mileage as the same quantity of a saturated gasoline. W. S. E. C.

362. Waxes from the Chlorination of Naphthalene. E. B. Halls. *Ind. Chem.*, 1933, **9**, 58–60.—Synthetic waxes have been produced in Germany to replace beeswax and Carnauba wax by esterifying montanic acids with montanic alcohols; recent experiments on the chlorination of naphthalene show that the product can replace ordinary paraffin wax in specific instances with definite advantages. These chloro-naphthalenes can be made by chlorination in the solid, liquid or vapour states and also in solution. Mixtures of poly-chloro-naphthalenes are obtained which are physically akin to paraffin waxes. An important outlet for refined waxes is the electrical industries, where insulation and dielectric properties are of great importance, and it is in this field that the chloro-naphthalene waxes are of especial value. Impermeability to moisture, non-tackiness, flexibility and high melt point are necessary properties for waxes for electrical use. Whereas the paraffins have advantage in respect of cost and abundance of supply, they usually have a limit of melt point of 65° C. with a tendency to crystalline structure and consequent porosity. Ceresines and beeswax can be used, but supply of the former is limited and the latter shows corrosion, which is to be avoided at all costs. Chloro-naphthalene waxes offer regular sources of supply and possess the following properties: M.Pt., 65–130° C.; density at 15·5° C., 1·5–1·7; specific inductive capacity, 4·5–5·5; colour, brown black to greenish yellow according to refinement.

They can be solidified with a compactness devoid of crystallisation and, their inductive capacity being twice that of paraffins, can be used for wax-impregnated paper condenser units with a reduction of 25–40% in size for a given capacity.

From their chemical composition some doubt as to their stability—*i.e.*, their non-corrosive properties—are entertained. The chlorine, however, is firmly bound in the napththalene ring, and on a well-refined wax no corrosion was detectable. Under test, the following are the characteristics of a given chloro-naphthalene wax: acidity, nil; ash on incineration, nil; volatility (loss on heating for 4 hours at 135° C. in metal dish), 13·7%; flow point, 95° C.; sp. gr. at 15·5° C., 1·563; colour, pale greenish yellow; action of copper dish (24 hours at 120° C.), nil. It is also definitely stable towards oxidation. R. E. D.

363. Manufacture of Asphalt from Cracking Process Residues. F. M. H. Taylor. *Ind. Chem.*, 1932, **8**, 429–432.—Asphalt from petroleum distillation residues are made chiefly by: (1) steam refining or steam distillation of the crude oil; (2) air refining or blowing process—distillation and dehydrogenation by air.

In blown asphalts the grade of product can be controlled by variation of temperature and time of blowing. Assessment of asphalts is derived from the tests of softening point, penetration, ductility, solubility, flash point and volatility. Laboratory experimentation on a black fuel oil highly thermalised of boiling range 412–660° F. gave results from which the following conclusions could be drawn: (1) air in place of steam gave increased yield and better quality of product, although time of reaction was lengthened; (2) use of agitator raised yield and improved the penetration value of product. Blown asphalt differs from steam-refined material in following respects: softer for the same melting point, more resilient, lower gravity, tensile strength and ductility lower, and lower softening susceptibility to heat

treatment. These conclusions were used in the design and erection of a plant with a weekly throughput of 30 tons of fuel oil, using a system of re-circulation of the distillate oil. Operation was by continuous process, and shape of vessel was designed to give maximum contact between air and oil, with the following advantages: (1) reduction of time of reaction or increased throughput; (2) less risk of spontaneous ignition of vapour due to poorer oxygen content of used air; (3) low air and fuel consumption.

Detailed description of the tower used as reaction vessel, together with practical details on air inlet, air supply, fuel oil supply, etc., is given, also a flow sheet of the whole asphalt plant.

Results show that the quality of asphalt can be varied under control between the limits of 0–30 penetration by increasing the quantity of gas oil converted into asphalt, and that residual oils from non-asphaltic base can be made to give asphalts with a wide range of properties, the yields varying from 50% to 95% by weight. R. E. D.

364. Preparations of Ethyl Alcohol from Ethylene (Pt. I). O. Pripik and E. Mezhebovskaya. *Refiner*, 1933, **12**, 70.—Using cracked gases containing an average content of 30-32% unsaturates, the method of Gen and Popov using activated charcoal for the absorption of ethylene has been further developed. The quantities and contact time of charcoal and gas permitting of the separation of ethylene either by absorption or by non-absorption were investigated by means of the determination of the M.P. and B.P's. of the bromides. For the preparation of pure ethyl alcohol it was found necessary to treat each 25 litres of gas with 100 gms. of charcoal. At this ratio some ethylene is absorbed by the charcoal but the bromides secured from the exit gas have a freezing point of +8° C. B. C. A.

365. Suggested Means for Detecting Harmful Gases and Protecting Workers in Oil Industry. J. L. Risinger. *Oil and Gas J.*, 9.2.33, **31** (38), 14.—In a paper presented before the petroleum section at the National Safety Congress, Washington, D.C., the author discusses the sources, explosive, asphyxiating, toxic and irritating properties, and physiological effects of the harmful gases encountered in the oil industry, and gives suggestions as to their means of detection and elimination and to the methods of protection against them.

Asphyxiation is due to the presence in air of:—(a) **Toxic gases**, which result in poisoning or suffocation, may be lead tetraethyl, carbon monoxide, or hydrogen sulphide. The Ethyl Corporation Protective Regulations render lead tetraethyl asphyxiation a minor problem, while carbon monoxide is only met with under local conditions of incomplete combustion. H_2S is the most dangerous asphyxiation gas as it is formed during distillation and refining as well as evolved from crude oil, and from the chemical reaction between soda and acid residues; (b) **Irritating gases**, which result in irritation of the eyes, breathing tracts and respiratory system, may be pentane, or higher homologous hydrocarbons, ammonia or chlorine. Pentane, etc., is found in the vapours of petroleum products and natural gas, possibly in conjunction with H_2S. Ammonia is used as a refrigerant and a treating agent for sulphur in petroleum products, while chlorine is used in water treatment; (c) **Asphyxiating gases**, the physiological effect of which is oxygen deficiency, may be nitrogen, methane, ethane, propane, butane, hydrogen or carbon dioxide. Methane, ethane, propane and butane occur in natural gas, hydrogen is used in welding or lead burning and is given off in charging storage batteries, while carbon dioxide is the product of complete combustion, and is used as a fire fighting agent and in inhalators as an aid to resuscitation. Special attention should be paid to the following points:

(1) In production, gas leaks round casinghead and other connections, gauging tanks, cleaning tanks, in cellars, on runways, etc.; (2) Pipeline, gauging tanks, cleaning tanks, leaks and breaks on lines, leaks in manifolds, leaks in pump houses, loading tank cars, cleaning and refilling tank cars, or pits around pump houses, etc.; (3) Refineries and gasoline plants, ships tanks, crude storage tanks, running fans, untreated distillate tanks, light oil treating plants, receiving houses, pump houses, tank pits, sewers, pipe trenches, cellars, beneath condenser boxes, between or under processing units or agitator foundations, on separators, working on operating units, pumps, lines, etc., or other locations and operations conducive to accumulation of these gases.

Elimination of these dangerous gases may be accomplished by:—(1) Ventilation, by proper construction of buildings, and spacing of units and by mechanical ventilation; (2) Operation of equipment so as to eliminate the necessity of employees entering enclosures or otherwise coming into contact with gases when this could be done at times when the gas hazard is absent; (3) Provision of traps to retain the gases and sealing of lines, etc.; (4) Vacuum control of toxic gases.

Important among the essentials in protection against asphyxiation are:—(1) The provision of equipment to meet the specific requirement of protection against each gas; (2) The training of employees in the use of equipment; (3) Observation by the employees of the safety regulations; (4) Training in resuscitation, preferably by the Schafer Prone Pressure method.

The properties of the asphyxiating vapours, toxic and irritating gases met within the industry are given and reference made to their physiological effect, toxic and explosive limits, detection and the necessary protection against them. C. L. G.

366. Cost Accounting and the Chemical Engineer (Pt. I). A. G. Peterkin and H. W. Jones. *Refiner*, 1933, **12**, 58.—Costing systems that have been employed in the past have been essentially postmortem in nature, and whilst serving as a basis for long term decisions and for the investigation of past efficiency have been of little use for the day to day supervision of plant operation. For the effective control of plant it is essential that the costs shall be current costs and that these costs shall be presented so that their incidence may be traceable to the causes, whether personal or impersonal responsible for them.

For this purpose systems of costing various terms, standard costs, budgetary control, etc., have been introduced, which, however have in common, the provision of a measurement of actual performance. The unit of measurement is a standard cost for each item of production and expense, which standard is previously agreed upon taking as a basis of computation either past experience, theoretical ideals or a hypothetical forward cost based on all the relevant circumstances such as past experience, current values, and present and potential demand. The factors affecting total cost are then separated and itemised so that variations may be traced to causes and the system is finally standardised so that the compilation of the costs may be made by clerical labour as a matter of routine. B. C. A.

367. Bolts and Flanges for Tanks and Heat Exchangers. C. O. Sandstrom. *Chem. Met. Eng.*, 1933, **40**, 67–71.—In this article attention is drawn to the lack of systematic knowledge on the distribution of pressure over a bolted flange. Methods of computing the gasket pressure and calculating the flange thickness are worked out. The tightening of the flange bolts of the spherical head of a pressure vessel is also discussed. G. R. N.

368. Patents on Crude Oil. J. S. Main. U.S.P. 1,894,958, 24.1.33. Apparatus for purifying oil by the use of hot water and steam.

M. de Groote. U.S.P. 1,897,574–5, 14.2.33. Process for breaking petroleum emulsions of the water-in-oil type. A demulsifying agent is used which contains an aromatic sulphonic body, the latter in concentrations of less than 1% producing a precipitate when diluted with an excess of alkaline salt solution. W. H. T.

369. Patents on Cracking. H. Dreyfus. E.P. 386,669, 9.1.33. Production of ethylene by cracking petroleum in the vapour phase with the aid of catalysts, which are dissolved or suspended in liquid heating media (molten inorganic compounds).

G. Zotas. E.P. 386,993, 23.1.33. Treatment of oil with steam at 200 lb. pressure and above 500° C. in a reaction chamber, the steam being subsequently condensed under pressure by heat exchange to the untreated oil.

Bat. Petr. Mij. E.P. 387,896, 16.2.33. Method of filtration of cracked residues through filter cloth covered with bleaching clay, for the removal of finely dispersed impurities.

I. G. Farbenind A.-G. E.P. 388,114, 23.2.33. Vapour-phase cracking with condensation of constituents boiling above 400° C. from the cracked vapours. The uncondensed vapours are added to vapours of fresh uncracked oil.

Houdry Process Corporation. E.P. 388,189, 23.2.33. Catalytic process for cracking, using successively a plurality of separate catalysts each capable of regeneration *in situ*.

Gulf Refining Co. E.P. 388,225, 23.2.33. Decomposition of oil by heating to 800°–1050° F. in the presence of hydrogen (0·5% by wt.), but in the absence of catalysts. The reaction products are cooled at such a rate as to preclude appreciable hydrogenation.

W. G. Laird. U.S.P. 1,894,355, 17.1.33. Liquid-phase cracking with special heat exchange arrangements for avoiding re-cracking of light products.

P. Zurcher. U.S.P. 1,895,063, 24.1.33. Catalytic conversion of oil in the vapour phase, using carbon heated to 300°–510° C. as catalyst. The carbon is activated by the combined action of steam and phosphoric acid.

W. Miller. U.S.P. 1,895,081, 24.1.33. Increasing the anti-knock value of motor fuel by superheating its vapour above 600° F., and then passing it through activated clay.

J. G. Alther. U.S.P. 1,895,873, 31.1.33. Liquid-phase cracking with minimum of coke formation.

H. T. Darlington. U.S.P. 1,896,165–6, 7.2.33. A circulating heater type of cracking plant fitted with means for withdrawal of vapour.

G. Egloff. U.S.P. 1,896,226, 7.2.33. Vapours from liquid-phase cracking, are passed to a vapour-phase cracking plant for the production of aromatic hydrocarbon and unsaturated gases.

G. Egloff. U.S.P. 1,896,228, 7.2.33. Production of high anti-knock fuel by treatment of oil from a cracking coil with heated water gas and air.

J. C. Black. U.S.P. 1,896,345, 7.2.33. A system of liquid-phase cracking, with special means for recycling and distillation.

S. Schwartz. U.S.P. 1,896,723, 7.2.33. Refining and cracking of petroleum with particular reference to heat economy and to the production of a motor fuel with a sharply defined end point.

G. Cash. U.S.P. 1,896,728, 7.2.33. Liquid-phase cracking with recycling of reflux condensate.

R. Tillmann. U.S.P. 1,896,986, 7.2.33. Cracking by passage of hydrocarbon vapours through a bath of molten lead, the latter being circulated by thermosiphonic action.

C. P. Dubbs. U.S.P. 1,897,245, 14.2.33. Continuous cracking system with provision for recycling and reduction of carbon formation.

C. W. Watson. U.S.P. 1,897,348, 14.2.33. Means for effecting uniform operating conditions for the different parts of a cracking system, thereby ensuring uniform products.

J. G. Alther. U.S.P. 1,897,567, 14.2.33. A cracking process, in which, after conversion of the unitial charge, the reflux condensate from the dephlegmator is returned and retreated separately in the heating zone to effect further conversion.

C. P. Dubbs. U.S.P. 1,897,576, 14.2.33. A continuous, non-residuum process, with control of the temperature of reaction in order to give a dry coke.

C. P. Dubbs. U.S.P. 1,897,577, 14.2.33. A liquid-phase process with a wide range of flexibility, operated at atmospheric or superatmospheric pressure.

J. Delattre-Seguy. U.S.P. 1,897,593, 14.2.33. Low-pressure conversion of oil, using heat radiated from combustion gases through a radiation partition.

C. H. Angell. U.S.P. 1,897,628, 14.2.33. A combined continuous distillation and cracking plant for handling crude oil.

C. P. Dubbs. U.S.P. 1,897,635, 14.2.33. A plant with the expansion chamber and dephlegmator combined.

H. L. Doherty. U.S.P. 1,898,245, 14.2.33. Cracking process giving the minimum amount of carbon and permanent gas, by the use of uniform heating and avoidance of local overheating.

H. L. Doherty. U.S.P. 1,898,246, 21.2.33. Continuous decomposition of heavy oils followed by accurate fractionation of the cracked distillate.

R. E. Wilson. U.S.P. 1,898,414, 21.2.33. A combined pressure still and fractionation means.

C. D. Bayne. U.S.P. 1,899,889, 28.2.33. Means for eliminating water from cracking stocks.

F. A. Howard. U.S.P. 1,899,895, 28.2.33. A cracking plant consisting of a heating coil and a thermally insulated digesting chamber.

M. E. Loomis. U.S.P. 1,899,897, 28.2.33. An improved plant and method for resolving cracked hydrocarbons into a series of marketable products.

W. H. T.

370. U.K. Patents on Coal and Shale. Maat. Expl. Bosch. Oct. E.P. 385,479, 29.12.32. Describes a process for removing gases and liquids from materials containing many capillary spaces, depending on the fall of tangenital pressure of the gas and liquid towards the outflow openings which is obtained by maintaining a temperature difference between the interior of the mass and the outflow openings. The removal of gas and liquid in this manner is more effective when an external pressure is simultaneously exerted on the mass. The operation is conducted in a pressure chamber, the walls of the press being heated and made permeable for gases and liquids.

C. L. Benn. E.P. 385,754, 5.1.33. Refers to the design of tar stills fitted with a dome-shaped bottom, which is corrugated so as to afford additional strength.

H. Wolf. E.P. 385,904, 5.1.33. Describes an adaptation of a pressure release valve (E.P. 297,829) to the distillation of tar oil under pressure.

B. Spitzer. E.P. 386,195, 12.1.33, a process for the complete gasification of bituminous coals of the caking variety in a gas or water-gas producer. The utilisation of this type of fuel is rendered possible by the grate of the producer being extended vertically to the level of the freshly charged fuel which is levelled and loosened by the application of a rotary rake.

Int. Bitum. Corp. E.P. 386,314, 11.1.33. Relates to improvements in the design and operation of apparatus for producing a domestic fuel from low-grade bituminous coal as described in E.P. 386,343 (see below).

Int. Bitum. Corp. E.P. 386,343, 19.1.33. Describes a process and apparatus for utilising low-grade bituminous coking coals or mixtures of these with non-coking coals, for the production of a solid domestic fuel with requisite burning properties. The raw material is mechanically charged into vertical tubular retorts and there pre-heated to expel moisture, etc. The pre-heated material is then mechanically charged into a battery of vertical tubular retorts, where it is carbonised at a temperature which is intermediate between that usually employed for high-temperature carbonisation and that employed for low-temperature carbonisation. Pressure is maintained by means of pistons on the mass of fuel during carbonisation, with the result that a coherent product suitable for domestic purposes is obtained.

Low Temp. Carbtn., Ltd., and others. E.P. 386,766, 26.1.33. Relates to the equipment of retorts described in Patent No. 277,079, whereby gas and air leakages caused by distortion of the cover plate are obviated by the provision of water seals at the essential points maintained by a continuous supply from the water jacket surrounding the vapour off-take pipe of the retort. S. B.

E. Citovich. E.P. 388,037, 10.2.33. Production of a gaseous fuel for C.I. engines which can be used without further compression. Continuous gasification of coal is effected in a high-pressure (50 atm.) generator by the introduction of steam and air. W. H. T.

371. Patents on Hydrogenation. British Colliery Owners Res. Assn. E.P. 387,415, 9.2.33. A process of destructive hydrogenation applicable to coals of little or no caking properties. The coal is preheated in the absence of added hydrogen or of oxidising gases, at a temperature not exceeding 470° C. and in the presence of a catalyst. Normal hydrogenation follows the pre-heating.

Chemical Reactions, Ltd. E.P. 388,171, 23.2.33. Reaction products of hydrogenation, while still under the working pressure are utilised for heating some of the product withdrawn from the distillation column and then returned to the column.

S. Löffler. U.S.P. 1,893,423, 3.1.33. This invention consists in employing, before, during and after the hydrogenation reaction, high-pressure steam for heating and cooling the materials taking part in the reaction.

M. Pier. U.S.P. 1,894,116, 10.1.33. Apparatus for hydrogenation in which the range of temperatures and pressures used, may be increased by the employment of double-walled apparatus constructed of chromium-alloy steels.

M. Pier and E. Anthes. U.S.P. 1,894,257, 10.1.33. Hydrogenation in which the gases are kept in a state of highly active movement in the reaction space, thus resulting in a more extensive intimate contacting of gases and vapours.

J. M. Jennings. U.S.P. 1,894,770, 17.1.33. Hydrogenation, using a solid catalyst, in which the ratio of asphalt to catalyst is below about 1·5.

J. Varga. U.S.P. 1,894,926, 17.1.33. Hydrogenation at 250°–700° C. and 100–500 atm. in the presence of tungsten catalyst and hydrogen sulphide (1–6% by wt. on the carbonaceous material).

M. Pier. U.S.P. 1,895,769, 31.1.33. Hydrogenation with vigorous circulation of carbonaceous material and catalyst in defined streams in order to prevent local thickening of the substances in the reaction chamber.

A. Spilker. U.S.P. 1,898,945–6, 21.1.33. Hydrogenation in the presence of iodine and of a metallic surface having the effect of iron. W. H. T.

372. Patents on Natural Gas. G. D. Gard. U.S.P. 1,898,579, 21.2.33.—Method and apparatus for separating vapours from gases with absorption oil which is recycled. W. H. T.

373. Patents on Motor Fuels. Improved Hydro-Carbon Processes. E.P. 387,447, 9.2.33.—Treatment of hydrocarbons in the vapour or liquid state with ozonised air, followed by agitation with a mixture of sulphuric acid and ferric chloride or sulphate. Neutralisation and redistillation completes the treatment.

F. E. Kimball. U.S.P. 1,892,801, 3.1.33. Vapour-phase refining, using a hot (300° F.) aqueous solution of calcium chloride (60-70%) and magnesium chloride (3-5%). After treatment, the vapours are fractionated and condensed.

A. Oberle. U.S.P. 1,893,438, 3.1.33. Refining cracked motor fuel by vapour-phase treatment with an aqueous solution of iodine.

H. T. Darlington. U.S.P. 1,893,667, 10.1.33. A dephlegmator for straight-run or cracked distillates, fitted with rotating discs for the removal of mist and for heat exchange purposes.

C. B. Watson. U.S.P. 1,894,331, 17.1.33. Continuous liquid-phase treatment of cracked fuels with fullers earth, using a pipe heater under pressure.

F. E. Kimball. U.S.P. 1,895,223, 24.1.33. Vapour-phase treatment of cracked gasoline with a hot aqueous solution of beryllium chloride and ammonium chloride.

R. C. Osterstrom. U.S.P. 1,897,328, 14.2.33. Decolorising and degumming cracked distillates by admixture with a catalyst and heating the mixture under pressure. The treated vapours are finally passed through a stationary bed of the catalyst.

J. C. Morrell and G. Egloff. U.S.P. 1,897,582, 14.2.33. Vapour-phase treatment of cracked distillates with sulphur trioxide and steam in the presence of ferric sulphate.

L. A. Meckler. U.S.P. 1,897,617, 14.2.33. Removal of mercaptans from distillates by subjecting the latter to the action of x-rays in the presence of oxygen.

J. C. Morrell. U.S.P. 1,897,618, 14.2.33. Recovering a condensate from the incondensible gas of a cracking reaction, by scrubbing with an absorption oil in a suitable scrubbing zone.

W. M. Malisoff. U.S.P. 1,899,042, 28.2.33. Desulphurising by means of a solution of an alkali sulphide in at least one solvent.

T. W. Culmer. U.S.P. 1,899,314, 28.2.33. Desulphurising by means of a cadmium-ammonia compound solution containing excess ammonia. W. H. T.

374. Patents on Lubricating Oil. W. W. Gary. U.S.P. 1,893,138, 3.1.33.—Refining with sulphuric anhydride diluted with liquid carbon dioxide in order to produce filterable reaction products.

R. A. Halloran and M. L. Chappell. U.S.P. 1,893,774, 10.1.33. Manufacture of lubricants by treatment of unsaturated oil (SO_2 extract) with aluminium chloride at a temperature suitable for polymerising the oil.

R. C. Osterstrom. U.S.P. 1,894,323, 17.1.33. Continuous treatment of oil with adsorbent at a temperature above the vaporisation point and under pressure to prevent vaporisation.

C. O. Hoover. U.S.P. 1,896,583, 7.2.33. A method of removing acid sludge from lubricating oil by means of a dry mixture of adsorbent and alkali, the latter being insufficient for complete neutralisation. The sludge thus collects in large soft grains which settle rapidly.

W. S. Baylis and D. S. Belden. U.S.P. 1,898,165, 21.2.33. Decolorising oils by the addition of a mixture of clay and water. The whole is heated and agitated until decolorisation is complete.

D. S. Belden. U.S.P. 1,898,168, 21.2.33. A heated mixture of oil and adsorbent is injected into a column, into the lower part of which is pumped an inert fixed gas (N_2). Heavy fractions and oily clay are removed from the bottom of the column, condensed fractions from the fractionating space, and fixed gas and uncondensible portion overhead. The fixed gas is separated and recycled. W. H. T.

375. Patents on Wax. A. D. Armstrong and G. Dobbie. U.S.P. 1,898,930; 21.2.33.—Apparatus for sweating wax, comprising a pan containing a foraminous shelf and a series of coils for heating and cooling. The coils serve to support the cake of wax.

E. Roeckner and F. Zschoch. U.S.P. 1,898,976, 21.2.33. Recovering Montan wax by hot extraction of brown coal with solvents under a pressure (1·1·5 atm) produced by increasing the temperature of the solvent. W. H. T.

376. Patents on Asphalts and Fluxes. H. A. Gill. E.P. 387,825, 16.2.33.—An emulsifying composition for the production of bituminous emulsions. The composition comprises saponified resin or saponified wax brought into solid form with the addition of a binding agent (asphalt). A filling material (Kieselguhr) may also be added. W. H. T.

377. Patents on Fuel Oil. Soc. Anon. Carboni. E.P. 387,115, 2.2.33.—A modification of E.P. 262,407, in which the air and atomised fuel mixture passes over an activated carbon catalyst at a temperature exceeding 250° C. prior to admission to the combustion space of I. C. engines. In the present patent the use of activated carbon in the form of a tangled mass such as carbonised wool or woven fabric is specified.

The catalyst is housed in a jacketed container heated by the circulation of exhaust gases. S. B.

378. Patents on Special Products. Trinidad Leaseholds, Ltd., and Others. E.P. 386,977, 18.1.33.—Acidic bodies are liberated from spent soda used in the treatment of cracked petroleum oils by the action of hydrogen sulphide or gases containing this gas. Separation of the oily layer containing the acidic bodies is promoted by the fractional addition of sulphuric acid and extraction with a light petroleum spirit. Distillation of the oil so obtained provides a fraction boiling between 180-270° C. which is subjected to a reducing treatment to convert disulphides to mercaptans, followed by further fractionation to separate suitable fractions which are oxidised back to disulphides and fractionated from the phenolic bodies which are thus obtained in a condition suitable for the preparation of disinfectants, insecticides, etc. S. B.

Du Pont de Nemours. E.P. 387,363, 24.1.33. A process of forming new substances which comprises the complete or partial polymerisation of a halogen-2- substituted butadiene-1, 3, by the aid of air or oxygen, heat, light, pressure or catalysts, at a temperature between —10° and 100° C. Polymerisation is controlled by the addition of an anti-catalyst.

H. Dreyfus. E.P. 387,372, 6.2.33. Manufacture of alcoholic oxidation products of olefines, the latter being oxidised by oxygen in the presence of water.

F. von Winkler and H. Haeuber. U.S.P. 1,894,255, 10.1.33. Production of liquid hydrocarbons at an elevated temperature from gaseous olefines and using a catalyst. The latter consists of heat resistant metal coated with tin, zinc, aluminium or chromium.

B. T. Brooks. U.S.P. 1,894,661, 17.1.33. A fraction of a mono and diolefine mixture consisting predominantly of butene and butadiene, is treated in the liquid phase with 60–80% sulphuric acid at 70°–80° F. Hydrocarbons not in solution in the acid are separated and polymerised material recovered therefrom. W. H. T.

379. Patents on Refinery Plant. T. T. Brown and J. W. Mitchell. E.P. 387,253, 2.2.33.—A safety device for oil fuel burners designed to prevent disconnection of the burner while the supply of fuel air and/or steam is turned on. The clamping screw fixing the burner in position at the furnace operates as part of the mechanism for controlling the supply valves. S. B.

H. Frischer. E.P. 387,569, 9.2.33. Recovering waste acid from acid tars. The waste acid is treated with nitric acid, the resulting nitric oxide being recovered and converted into higher oxides of nitrogen.

L. W. Snell. U.S.P. Re 18,722, 24.1.33. Distillation, using a fractionating condenser whose operation is controlled by the return of cooled liquid products.

P. R. Gray. U.S.P. 1,892,764, 3.1.33. A method for converting the heat of vapour under pressure into mechanical work, by means of a vapour engine. The exhaust vapour is returned to the fractionator.

J. Primrose and H. R. Swanson. U.S.P. 1,893,906, 10.1.33. An improved form of bubble tray, allowing for proper distribution of liquid, elimination of entrained liquid from vapours and withdrawal of condensate at any one of a number of different levels.

J. Primrose. U.S.P. 1,893,907, 10.1.33. Apparatus for distillation of lubricating oil fractions with small overlapping from the viscosity standpoint. The plant consists of tubular oil heater and fractionating tower, steam being introduced at the bottom of the column to minimise cracking.

D. G. Brandt. U.S.P. 1,894,215, 10.1.33. Method for controlling the fire box temperature in pipe still furnaces. Tube shields are provided to absorb heat from the burning gases, and the furnace temperature is further controlled by injecting convection gases into the fire box.

E. W. Roth and P. W. Prutyman. U.S.P. 1,895,683, 31.1.33. Treating plant, consisting of adjoining troughs communicating at alternate ends, oil and reagent flowing counter-currently and continuously.

R. P. Brown. U.S.P. 1,895,701, 31.1.33. Method of regulating the heat supplied to a tube heater, so that oil passes from the plant at a constant exit temperature.

R. E. Nagel. U.S.P. 1,896,245, 7.2.33. A dephlegmator for handling sulphurous oils, fitted with a liner of non-corrosive material.

K. T. Steik. U.S.P. 1,896,470, 7.2.33. Treatment of oils, the heavier treating liquid being atomised above the surface of the lighter liquid. Fresh surfaces of the latter are brought into contact in cyclic circulation with the atomised liquid.

F. Govers. U.S.P. 1,896,618, 7.2.33. Vacuum distillation apparatus consisting of a shell and circulation heating tubes.

A. E. Harnsberger and A. L. Christy. U.S.P. 1,897,389, 14.2.33. Apparatus for treating cracked distillates with fullers earth. The latter is mixed with the oil and the mixture passed to a pipe-still and thence to a fractionating tower.

J. Primrose. U.S.P. 1,897,766, 14.2.33. An improved construction and arrangement for a fractionating tower.

C. F. Denney. U.S.P. 1,899,081, 28.2.33. A vacuum, fractionating tower with means for the supply of steam to the column.

R. E. Wilson. U.S.P. 1,899,918, 28.2.33. Fractionating column for cracked distillates. W. H. T.

Class 700. Utilisation.

380. Alcohol-Gasoline Blends in U.S.A. Anon. *Oil and Gas J.*, 26.1.33, **31** (36), 28.—Proposals have been made to blend alcohol produced from grain, etc., with gasoline in the U.S. The differences in the economic aspects of the proposal in the U.S. and in other countries already utilising such mixtures are indicated. Technical difficulties pointed out are: (1) The calorific value of alcohol per gal. is lower than that of gasoline, resulting in higher consumption when using alcohol-gasoline blends; (2) the superior anti-knock value of the mixtures is somewhat illusory since under severe high temperature driving conditions there is a considerable deterioration in the anti-knock effect indicated under relatively moderate test conditions; (3) changing of jets may be necessary when mixtures containing substantial amounts of alcohol are used; (4) cork floats are attacked by the mixtures and there is a tendency to corrode fuel systems; (5) the mixtures are "hard starting" and would give trouble in North Central U.S. winters; (6) the possibility of separation of the mixture into two layers in the presence of small amounts of water, especially if alcohol of 95% strength, as manufactured by normal processes, is employed. These difficulties are not so pronounced in other countries where (*a*) in many cases the mixtures are stored and sold in tins and protected from contact with water or atmospheric moisture until loaded into the customers fuel tank; (*b*) the availability of benzole, which reduces the danger of separation when added as a constituent of the mixture, is not so limited as in the U.S. R. A. E.

381. Carbon Monoxide and Hydrogen. F. Rosendahl. *Petr. Zeit.*, 8.2.33, 1933, **29** (6), 1–14.—This is a résumé of work carried out on water-gas conversion—*i.e.*, the synthesis of methanol, preparation of organic compounds (higher alcohols, ketones, etc.), and the production of liquid hydrocarbons similar to petroleum. The work is described and numerous references are given including patent specifications. W. S. E. C.

382. Distribution of Butane in Light Gas Cylinders. A. Grebel. *Matt. Grasses.*, 15.11.32, No. 295, 9669–9671.—An account of a six months' trial of the use of liquefied butane for domestic purposes in France. The butane is liquefied at 15° C. under 1·620 kilograms/sq. cm. A special cylinder is used of 25 cub. dcms. capacity and weighing 12 kgs. empty and 25 kgs. full. A special arrangement is provided for bringing the cylinders into use consisting of special caps, and pressure regulating valves. Diagrams are given. The gas can be used for all domestic purposes. It is delivered to the pipe system at a uniform pressure of 200 mm. of water. The cooling effect due to the evaporation of the butane is insufficient to cause difficulty if the cylinders are left in a current of air. It is necessary for the butane to be well fractionated, and, in particular free from higher boiling constituents.

The employment of this butane necessitates alteration of the normal burner used for town gas; but, in general, it suffices to decrease the diameter of the orifice. The pipe system is specified to be of copper of 6–8 mm. internal diameter. The cost is about 0·50 Frs. a therm against 0·20 Frs. for town gas. The author points put that the low pressure of the butane renders it very safe in use, and is therefore preferable to town gas stored in gas cylinders under much higher pressures. S. T. M.

383. Asphalt-Impregnated Tile. Anon. *Chem. Met. Eng.*, 1933, **40**, 81.—Experiments conducted over a period of years at Los Angeles Harbour have shown that concrete piers could be insulated against the destructive effects

of the sulphates in sea water by impregnation of the piers with asphalt under the vacuum-pressure process. The latter has now been extended to the asphalt-impregnation of tile and impregnation to a depth of 2 in. can be obtained. Tile, so treated, resists the action of 50% and 75% sulphuric acid. For the production of the tile, a clay is used with a minimum amount of non-colloidal material and free from mineral sulphates and other solubles, which bakes with a certain degree of porosity, *i.e.*, not too dense to prevent thorough impregnation of the asphalt. The use of asphalt impregnated tile constitutes an effective and economical method of insulating pickling vats.

G. R. N.

384. Design and Testing of Asphalt Paving Mixtures. N. H. Taylor. *J.S.C.I.*, 1932, **51**, 415T–433T.—The standard grading suggested by Richardson in 1905 has long been accepted as the ideal grading for use in asphalt paving mixtures. This grading was the result of a series of analyses of successful pavings laid in the United States, and its success was due to the mixture having a low percentage of voids. Recent work has shown that, providing the proportions of bitumen and filler are adjusted to give a mixture with a low percentage of voids, the sand grading can be varied considerably, but even then it is usually necessary to mix two or more sands. The percentage of voids in a paving mixture bears a relationship to the durability and stability of the pavement, and the quantity of bitumen required is the amount that will as nearly as possible fill the voids in the mineral aggregate, although it is seldom possible to reduce the voids below 2%. Various methods for determining voids are discussed, the method adopted by the author being to compress the aggregate either dry, or mixed with a medium such as castor oil, in order to determine the correct grading for the mineral aggregate, and then to make mixtures with increasing bitumen content and ascertain the voids in briquettes of each mixture compressed at 5000 lb./sq. in.

Typical fillers were examined for particle size, voids in mixtures with a standard sand, the effect of water on fillers and the stabilising effect of the filler on bitumen. Curves and tables are given and a test for fineness of the filler is described. The efficiency of a filler generally increases with fineness, and there is a relationship between the voids in the filler and the amount of filler which can be added to sand with continued reduction in voids. Limestone and cement fillers were found to be highly resistant to the action of water. Granite dust was affected to a very great extent, while care in the mixing process is necessary if clay is used. The failure of paving in Singapore is attributed to the use of granite dust filler, as mixtures of identical composition except that cement filler was used, are in perfect condition after eight years. Filler has a stabilising action on the bitumen which varies widely with different fillers and the proportion used. The fineness of a filler has a direct bearing on its stabilising properties, the rise in melting point of the bitumen-filler mixture is not inversely proportional to the average particle diameter of the filler, but the author suggests that the rise in melting point may be roughly expressed by $R = K/\sqrt{D}$, where R is the rise in melting point, D the average diameter of the filler and K the stabilising power of the filler, varying with the type of filler and the ratio (volume of filler) / (volume of bitumen).

Tables and curves are given showing: Specific gravity, voids, impact resistance and stability of compressed paving mixtures containing various proportions of bitumen and fillers of different types. A new type of stability apparatus for mixtures containing stone is described. The test piece is a disc 4½ in. diameter and 1½ in. deep, which has been compressed at 160°

under a pressure of 5000 lb./sq. in. The specimen is maintained at 60° for 1 hour before testing, and is then transferred to the oven of the machine. A uniformly increasing load, 500 lb./minute, is applied to a central area 2 in. diameter. Plastic deformation occurs, and a stress is set up in the annular ring of unloaded material which causes a failure by tension. The disc is placed on the ram of a hydraulic press and the load applied by pumping at such a rate as to ensure uniformity. The load and deformation are recorded by an autographic attachment. A typical chart is shown. Failure is quite definite, and tests check very closely. The conditions which a paving mixture must satisfy for use in Singapore are given, and the characteristics of three bitumens of 30/40 penetration which are available in Singapore are tabulated. A. O.

385. Preparation of Asphalt-Mineral Mixes for Use in the Cold. T. Temme. *Bitumen*, 1932, **2**, 185–189.—A description is given of naturally occurring asphaltic mineral material which can be crushed, transported and then used without the application of heat. As an example the composition of Kyrock asphalt sand is given as follows: Volume weight of compressed sample 1·951, bitumen content (by weight) 6·55, (by volume) 12·57, sp. gr. of asphalt 1·032, volume weight of mineral matter 1·823, sp. gr. of mineral matter 2·652. Mineral content of compressed sample (by volume) 68·8%. The recovered bitumen has a dropping point 48·5° C., melting point (K. and S.) 22·0° C. (R. and B.) 29·0° C.

Many artificial methods have been tried to imitate these materials. Generally speaking they consist in reducing the fluidity of the asphalt with an oil of suitable boiling range, mixing with stone of suitable size and then allowing the thinner to evaporate. The proportions of the constituents vary with the kind of stone and bitumen and also with climatic conditions.

The preparation of the surface coat is briefly described, the grain size of the under coat being 0–30 or 0–40 mm. and of the top coat 0–8 to 0–15 mm.

Various patents (from 1909 onwards) are briefly mentioned. A process in which the stone is previously wetted with oil has certain advantages. C. C.

386. An Investigation on Petroleum Oils for Malarial Control Purposes. G. C. Ramsay and J. A. Carpenter. *Rec. Malaria Surv., India*, 1932, **3**, 203–218.—There are great variations in the larvicidal properties of petroleum oils; the various petroleum products, available in India, were examined in order to find a highly efficient larvicide. The ideal larvicide has high toxicity to the larvæ, but at the same time is harmless to higher forms of life; good spreading power on water; a good lasting power without falling off in efficiency. Taking into account these various points the authors conclude that the viscosity of the larvicide should be between 3–15 c.p. at 25° C., and preferably nearer the lower limit. As the killing effect is not only one of asphyxiation, but also of toxic poisoning, the oil used must have both viscosity and surface tension effects adjusted, so that the oil can enter the breathing tubes and the mouths of the larvæ, and also high toxic properties so that the oil may kill as rapidly as possible.

It has been found that aromatic and unsaturated oils, extracted or produced from certain ranges, or "ends" of oil, and blended in the correct proportions approximate very closely to the ideal requirements. They are abnormally toxic to weeds, insects and larvæ; spread well, but do not kill fish unless shaken with the water. The majority of anopheline larvæ are killed in 2–5 mins. (against ½–1 hr. for ordinary oils), and stegomyia larvæ in 20 mins. (against several hours with ordinary oils). The authors are not generally

in favour of adding special substances, but state 2–5 per cent. of creosote oil aids in the burning of weeds.

Attention is drawn to the importance of using the right type of sprayer and keeping it in good order. The amount of oil used should not be less than 4–5 ounces/100 sq. ft. In spraying a running stream the operator should walk against the stream.

A description of the experimental method employed for investigating the effects of different oils is given. 100 larvæ of about the same size are placed in an open porcelain basin containing water at 80–85° F., so that a water surface of 8·8 in. diameter is exposed. Oil is added in the equivalent of 5½ oz./100 sq. ft. Different cuts, types and blends of oils were used. The results showed that light oils were the most killing, and when the average b.p. of the cut rises above 200° C. the toxic effect diminishes. When, however, special cuts of aromatics and unsaturateds are prepared, it is possible to make up blends of equal, or better, killing power than light cuts. Tables of experimental results are given. S. T. M.

387. Briquetting Pitch from Tars and Tar Oils. *Chem. Trade J.*, 1933, **92**, 177.—A process has been developed in Germany for the production of pitch-like products by blowing air through heated tar or tar oil, which causes resinification and polymerisation. Dehydrated coke-oven tar yields 75 per cent. of pitch and tar oils 50 per cent., the yield increasing with the duration of the process and with the presence of sulphur gases in the air employed. The synthetic pitch has been found as useful for briquetting as ordinary pitch, of which there is a shortage in Germany at present. C. L. G.

388. Colophony as Electrical Insulating Material. P. Nowak. *Erdöl u. Teer.*, 1933, **9**, 91–93.—Mixed with mineral oil, rosin is an important constituent of some impregnating compounds for high-tension cables. A 25% rosin blend shows less susceptibility to oxidation than the straight mineral oil. Rosins vary considerably in composition and electrical properties.

Oxyacids were isolated from a sample of American I. rosin, and it was shown that, while they showed little difference in resistivity from the original rosin, when the proportion of oxyacids in the latter exceeded some 10% the compound showed considerably less resistance owing to separation of these acids which are not very soluble in mineral oil.

It was established that the fluid constituents of the rosins have an important effect on the electrical characteristics. 3% by weight of red-brown liquid was obtained by heating I. rosin at 120° C. under 15 mm. pressure. At normal pressure 75% of this fluid distilled between 160–170° C. While this constituent appeared to have little effect on the electrical properties, the residual 25%—a resinous oil—showed very poor results in this respect and, in addition, rapidly corroded copper and lead.

A table compares an impregnating compound containing 30% of rosin with a similar compound made with rosin which had been subjected to heating *in vacuo*. The latter shows a higher resistance and a considerably lower decrease in resistance after oxidation (23% compared with 48%). In addition, this compound is less sensitive to separation of rosin on standing.

The acid anhydride shows less conductivity than the corresponding acid, and a table indicates the resistivity at 100° C. of blends of mineral oil containing 25% of commercial I. rosin, 25% abietic anhydride, acid No. 12 (prepared by Fourobert and Pallauf's method—*Farben Ztg.*, 1925, **31**, 1849), and 25% of abietic anhydride, acid No. 0 (recrystallised from petroleum

ether and heated *in vacuo*). The last blend shows only 6·5% reduction in resistivity after 10 hours' oxidation compared with 49% given by the original rosin. C. C.

389. Rosin-Wax Sizes. R. B. Ladoo. *Chem. Met. Eng.*, 1933, **40**, 89–90. —Rosin-wax sizes are emulsions of wax in rosin soap. In rosin-wax emulsions, water is the liquid, rosin soap the emulsifying agent and a blend of wax and rosin the emulsified material. The emulsion particles generally have an average diameter of about one-twentieth thousandth of an inch. The most widely used rosin-wax sizes are prepared by the Bennett process, which employs a specially designed dispersion machine. The most commonly used rosin-wax size consists of 81% rosin and 19% paraffin wax in a 40% concentration emulsion. Rosin-wax sizes are used in the same manner as rosin size over which they hold a number of advantages, particularly in connection with the sizing of paper. These advantages are enumerated and include superior flexibility, improved sizing, increase water resistance, better gloss, etc. G. R. N.

390. Patents on Kerosine Burners. J. Imber. E.P. 386,986, 27.1.33. A lamp or burner of the blue-flame wick type is described which includes a central air tube into which air ports lead and a vertical vane placed outside and adjacent to each port so as to prevent interference with a steady flow of air by removing extraneous draughts.

E. A. Hailwood. E.P. 387,689, 8.2.33. A flame-controlling device consisting of a movable plate or head placed adjacent to the wick tube facilitates the wick-trimming by altering the flow of air to the flame and straightening out the ragged part of the flame. W. S. E. C.

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ABSTRACTS.

Class 100. Geographic Occurrence.

391. Voshell Field, McPherson County, Kansas. T. C. Hiestand. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 169–191.—This field, which was discovered in 1929, lies in the McPherson County, Kansas. The pool lies on a narrow anticline extending in a north south direction. Production is obtained entirely from the pre-Pennsylvanian beds, and is obtained from three limestone and two sandstone horizons in the Mississippian and the Ordovician, the chief horizon being the Wilcox Sand. There is a strong angular unconformity between the Pennsylvanian and the underlying beds, and the latter are much more definitely folded and faulted than the former. The structure in the beds above the unconformity merely reflects the faulted anticline below and shows only a gentle curvature.

The oil and gas accumulation shows a marked relation to the area of closure, and during the process of production the water movement appears to be the chief propulsive agent in the oil withdrawal.

The paper contains maps and sections to illustrate the structure and geological sequence. It also includes notes on the waters found in the field, and an account of the drilling and production practice. V. C. I.

392. Darst Creek Oil Field, Guadalupe County, Texas. H. D. McCallum. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 16–37.—This oilpool lies to the east of one of the echelon faults which lie to the east of the Balcones Fault of Texas. The trap consists of a fault about 6 miles long with a maximum vertical displacement of 550 ft. measured in the Edwards Limestone.

The beds exposed at the surface are basal Eocene, and the structure is indicated at the surface by abnormal dips and by repetition of the outcrop. Oil migration was from the east, and the producing field is on this side of the fault plane. The main producing horizon is the Edwards Limestone, but some oil is found in cavities in the Taylor Marl and Austin Chalk and also in Serpentine.

Several sources have been suggested for the oil, the author preferring the suggestion that it is indigenous to the Edwards Limestone.

The producing area is nearly 3 square miles, and has been drilled by 291 wells, which have practically completely defined the production area.

The paper is illustrated by maps and sections of the structure, and gives a complete section of the stratigraphical column. V. C. I.

393. Geology of the McKittrick Oil Field and Vicinity, Kern County, California. J. A. Taff. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 1–15.—The McKittrick field is one of the most complicated tectonic units of all the Californian group of oilpools. It presents a mass of contorted Monterey shales overriding a series of beds of the same formation but with a simpler structure. The generally accepted explanation is that of R. Arnold and R. H. Johnson, which considers that an important overthrust fault with movement in an easterly direction is the probable explanation of the observed phenomena.

In this paper the author summarises the stratigraphy and the structure, and then presents a new explanation of the genesis of the structure. He considers that the primary reason for the disturbances are to be found in the elevation of the Temblor Range, and the folding and faulting of a thick mass of Miocene strata. In Pleistocene times these beds, partially lubricated by water, and under the force of their own weight, began to slide downhill.

The movement thus started culminated in a total drop of about 2000 ft. and a forward movement of about 2 to 3 miles, and resulted in the overlap and capping of Miocene and Pliocene strata by the moving blocks of Miocene shale.

These gravity slides were progressive, and it is contended that they are still proceeding to a certain extent. V. C. I.

394. Pre-Tertiary Rocks from Deep Wells at Jackson, Mississippi. W. H. Munroe. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 38–51.—This paper gives an account of the formations below the Eocene beds of the gas field at Jackson. These include the Upper Cretaceous Chalk and volcanic equivalents of the Woodbine Sand. At the base lie steeply dipping rocks, probably of carboniferous age. The suggestion is that the Appalachian fold system passes through Mississippi at this point. V. C. I.

395. Sulphur Content of Crude Naphtha from Turner Valley in Relation to Refining Practice. J. W. Shipley. *Canad. J. Res.*, 1933, **8**, 119.—Typical samples of Turner Valley naphtha have been examined with regard to sulphur content and behaviour towards common refining agents. The sulphur content ranged from 0·15 to 0·19% and consisted of sulphides, organic disulphides and mercaptans. Thiophenes were present in very small quantities, but no free sulphur or peroxides were detected. Colour and gum-producing compounds could be concentrated in a small residue from distillation. Exposure to light, even in the absence of air, caused the development of colour and gum in all undistilled samples treated or untreated. Distillation up to 165° C. yielded a fraction which remained colourless and free from gum formation when exposed to air and light for over eight months. Treatment of the crude naphtha with sodium hydroxide solution or with alkaline sodium sulphide solution followed by distillation is suggested as a means of producing a fairly satisfactory gasoline. The caustic wash alone reduced the sulphur content to about 0·1% and the sodium sulphide solution reduced it to 0·05%. Sulphuric acid, sodium hypochlorite, caustic soda, sodium plumbite and cupric chloride treatments did not prevent colour or gum formation when the refined samples were exposed to light. W. H. T.

396. Varying Properties of Mexican Crudes. E. F. Nelson and G. Egloff. *Oil and Gas J.*, 9.3.33, **31** (42), 16.—Active production in Mexico commenced in 1901 in the Ebano Field in the Panuco River basin near Tampico. In 1902 the Isthmus of Tehuantepec was explored, and in 1907 the Cougas Field, now called Furbero, was opened successfully. The producing areas of Panuco and Topila in the Panuco River basin, and the Juan Casiano and Potrero del Llano fields were discovered in 1910. Production in all fields increased rapidly to the peak year of 1921 with the "Golden Lane" of Tuxpan, when Mexico held second place in the world petroleum production with 193,397,587 brls. From 1921 production declined to the estimated figure of 32,000,000 brls. in 1932. Other important fields in Mexico are the Alamo in Tuxpan, the Cerro Azul in Tepezintla (Vera Cruz) and Los Naranjos in Amatlan (Vera Cruz). Mexico's potential oil-bearing lands are estimated at 150,000,000 acres, of which about 0·01% has been exploited.

The first refinery was started in Furbero in 1870, the combined refining capacity of Mexico being now given as 340,000 brls. per day, the chief refiners being El Aguila, Huasteca, Pierce Oil and La Corona in Tampico, and El Aguila in the Isthmus. The crudes oils are of two types, the heavy asphaltic type

and the light paraffin base crude, those of Tehuantepec, Tobasco and Chiapas being especially light and rich in lubricants.

The properties and distillation characteristics of the following crudes are given: Tuxpan, Panuco, Ochoa, Alamo, Cerro Azul, Chapopote Nunez, Potrero del Llano, Tierra Blanca, Toteco, Gonzalo, Topila and Zurita.

Cracking tests on various products from Naranjos crude are given. Cracking the crude oil, kerosine, naphtha and pressed oil gave respectively 40% of gasoline (O.N. 67), 73·8% of gasoline (O.N. 71), 83% of gasoline (O.N. 69) (or 66% of gasoline (O.N. 79)) and 58% of gasoline (O.N. 77).

Analyses of charging stocks, cracked gasoline and residues from these stocks are given. C. L. G.

397. Oil and Geophysics in North-West Germany. O. Barsch. *Zeit. Deut. geol. Gesell.*, 1932, No. 6, pp. 437–449.—In the search for oil and salt domes in North-West Germany, one must start with the regional study of geophysical phenomena, to avoid useless and unnecessary detailed work. The old buried uplifts and basins of the North-German Plain have governed the sedimentation and folding movements of later times. The old massifs took no part in the sedimentation of the mesozoic strata and have suffered little from the later tectonic movements. No salt domes were discovered over such areas.

It was first in the peripheral zone of basins where the sedimentation was undisturbed and the later folding movements were most intensive. The repeatedly renewed activity of these old fault systems made the upward movement of the salt possible. It follows that in search for oil and for salt domes the knowledge of the old uplifts and of their marginal zones is of great importance. Their existence is connected with an increased gravitational force and greater magnetic intensity. Therefore they are easily detectable by geophysical measurements.

The results of pendulum measurements in Germany clearly indicate the existence of old buried massifs and uplifts such as Pompeckj and Flechtingen as against the Subhercynian Basins and the "Weserbucht."

The magnetic map of Schleswig-Holstein shows clearly the structural elements of this Province, the Hercynian trend in the North and the N.-S. trend in the South. The importance of the regional study of geophysical phenomena is made clear by the position of the salt domes in this area, like those of Lieth at Elmshorn, Langfelde at Hamburg and Seberg, all of which are located on the marginal area of magnetic maxima. O. W.

398. Siberian Oil-bearing Areas. Anon. *Petr. Times*, 1933, **29**, 401.—There is evidence of oil in the upper reaches of rivers Chebyda, Tongo, Botmai and Sinei, and bitumen along the Olenek. In Eastern Siberia oil shows are confined to the eastern and southern shores of Lake Baikal. Layers of oil and ozokerite are found in the Quaternaries, and the cracks below, with oil-sands in the bottom of the lake at three places, from which oil escapes to the surface. Gas is more common than oil. Near Tanhoi is a patch of sand and clay layers with intercalations of brownish coal, and while the sands are highly saturated with oil, the clay and coal layers are devoid of oil. A species of ozokerite is also washed ashore. Around the lake the oil shows appear to be associated with tertiary beds, but on the river Angara, and in the basin of the Kana the age is Silurian.

In Western Siberia the Minussinsk area has a dark bituminous limestone smelling of oil (Ordovician of Minussinsk valley). In the centre bitumen is found filling the cracks and cavities in the basic igneous rocks, apparently due to the magma acting on Palæozoic bituminous limestone. A similar occurrence is found in the neighbouring Kuznezky valley G. D. H.

399. Occurrence, Nature and Origin of Asphaltites in Limestone and Oil Shale Deposits in Estonia. P. N. Kogerman. *J. Inst. Petr. Techn.*, 1933, **19**, 215–222.—The analysis of solid bitumens from Estonian limestone and oil shale is detailed; their asphaltite origin is indicated and some conclusions regarding their formation are given. G. R. N.

See also Abstract No. 320.

Class 200. Geology and Origin.

400. Controlled Aerial Mapping in the Gulf Coast. J. Atkinson. *Oil Weekly*, 20.3.33, **69** (1), 9.—Controlled aerial mapping has enabled detailed surface information to be obtained rapidly and at a reasonable cost.

Structural indications have been found by close study and the geologist is enabled to pick out likely areas and concentrate his field work on them. In the field, aerial maps permit the chief of the party to place his crew without waste of time since interstation distances are obtained by simply scaling on the photograph.

In a similar way these photographs become invaluable for engineering and lease work. L. V. W. C.

401. Microflora of Oil Waters and Oil Bearing Formations and Biochemical Processes Caused by It. L. T. Ginsburg-Karagitscheva. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 52–65.—This is an account of the examination of over 100 samples of the waters from sulphurous springs and oil wells in the Caucasian oilfields. This examination disclosed the presence of micro-organisms normally associated with hydro-sulphurous fermentation.

The sulphates were reduced to sulphuretted hydrogen and also anatrobic decomposition produced methane, hydrogen, carbon dioxide, ammonia and mercaptans.

Admission of oxygen inhibited the fermentation and changes in the salinity altered the rapidity of the changes noted.

It is suggested that the results have a direct bearing on the origin of the oil and gas and on the disappearance of sulphates in oilfield brines. V. C. I.

402. Base-Replacement Studies of Oklahoma Shales—Critique of Taylor Hypothesis. L. C. Case. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 66–79.—This paper is an attempt to examine the validity of the hypothesis of McKenzie Taylor by analysis of the sediments associated with the producing horizons in Oklahoma.

The author considers that the data does not support the belief that leaching of the shales over the oil sands has taken place. In the main the predominant types of shale examined had alkaline pH values and this criterion is of little use as a basis of correlation. V. C. I.

403. Calculation of the Motion of the Ground from Seismograms. H. A. Wilson. *Physics*, 1932, **2**, 186.—From the records of mechanical seismometers having a definite self-period and damping co-efficient, the motion of the ground can be computed. In homogeneous ground an explosion of dynamite would produce single waves, or short trains of waves. The motion of the seismographs is considered for the aforesaid case.

With regard to the motion of an undamped seismograph :—(*a*) The period of the seismograph is greater than that of the waves in the ground. In this case the undamped seismograph records the first wave fairly accurately. It gives a very marked deflection due to the first impulse, this is an advantage, since a large deflection is less likely to be overlooked or obliterated by the small oscillations due to local disturbances; (*b*) the period of the seismograph is equal to that of the waves. In this case the amplitude of the first oscillation is small, but the amplitude rapidly increases as the successive waves arrive; (*c*) the period of the seismograph is smaller than that of the waves. In this case the amplitudes are very small.

In the case of a critically damped seismograph :—(*d*) The period of the seismograph is longer than that of the waves, in which case the critical damping cuts out the oscillations of the seismograph, set up at the start, so that we do not get interference between two vibrations of different frequencies; (*e*) the periods of the waves and of the seismograph are equal, in this case the seismograph is less sensitive and the motion of the ground and that of the instrument does not agree as well as in case (*d*); (*f*) a critically damped seismograph with a period very small compared with that of the waves in the ground, gives a deflection very nearly proportional to the acceleration of the ground. It is difficult to make such an instrument sufficiently sensitive because of the small ratio of the maximum value of the amplitude of the motion of the ground and of the seismograph.

It appears from the above results that the only case in which the deflection of the seismograph is approximately equal and opposite to that of the ground during the passage of one or more waves is that of an undamped seismograph with period much larger than that of the waves. In this case, however, a single wave sets up an oscillation, which continues indefinitely. Critically damped seismographs are obviously better when it is desired to observe the arrival of several waves separated by appreciable intervals. O. W.

404. Study on the Theory of the Reflection and Refraction of Elastic Waves on the Surface between Two Different Media. H. Blut. *Zeit. Geophysik*, 1932, No. 3/4, pp. 130–144.—The ratio of the amplitudes and of the energy of the direct and reflected longitudinal and transversal waves is a function of: (*a*) The velocity of the elastic waves in the media; (*b*) the density of the media; (*c*) the angle of incidence.

The amplitude and energy ratio is calculated according to the theory of Zoepritz brought into an explicit form. O. W.

405. Static Method for Measuring the Relative Value of the Gravitational Force. H. Halck. *Zeit. Geophysik*, 1931, No. 1/2, 1932, Nos. 1/2 and 5.—The change of the gravitational force is calculated by measuring the change of the height of a mercury column in a closed U tube, kept in equilibrium by a volume of gas. Difficulty arises against the application of this old principle through the disturbances due to temperature changes. A change of 0·001 C° produces an error of one milligal in the measurement of the gravitational force. In spite of different and careful temperature compensation arrangements, the accuracy of the field measurements remained only +10 milligals.

The instrument is placed in a cylindrical container filled with ice and is suspended from a frame work fixed on a motor truck. Total height of the instrument is 180 cm. diameter 65 cm., weight 300 kg. O. W.

See also Abstract No. 397.

Class 300. Development and Production.

406. Special Methods Required to Drill Through Overhanging Cap Rock and Salt. S. A. Judson and J. C. Battle. *Oil Weekly*, 20.3.33, **69** (1), 59.—Special methods were required to drill successfully through the cap rock and salt of the overhangs in the Barbers Hill and other fields of Texas and Louisiana.

Near the base of the unconsolidated sands and shales above the cap rock is a broken sandstone resulting from the cementing action of the lime-charged waters percolating into the loose sands immediately above the cap rock. The upper portion of the cap rock proper consists of impure calcite, sometimes 100 to 200 ft. thick, which is often porous and occasionally cavernous, separated by a narrow zone of gypsum and selenite from the anhydrite beneath. It is this zone which causes the drilling difficulties, and the bit will often drop as far as 25 ft. without hitting anything. The bottom zone of the cap rock consists of massive anhydrite with occasional cavities at its contact with the salt.

The unconsolidated sands and shales above the dome are quickly and easily drilled and a 20-in. conductor pipe is set and cemented. Through this string is set a 13¾-in. O/D. casing on top of the calcite zone of the cap rock proper. Great care is exercised to set this string as soon as the extreme top of this zone is reached, since cavities or caverns may be encountered through which the drilling fluid would be lost. These caverns have a probable ultimate connection with the shallow sands above the cap rock, allowing the movement of fluid under additional pressure, since the level of the fluid in the hole falls when a cavity is encountered.

Several methods have been developed by which it is possible to drill ahead through and below a cavernous or porous zone of the cap rock. The upper zone of cavities in the calcite is usually cemented with ordinary cement to which has been added a small amount of bentonite. This bentonite causes the cement to fill and shut off these caverns.

In the gypsum-selenite zone, which usually contains large irregular caverns, the principal method employed is to place successive batches of the special bentonitic cement until the portion of the cavern adjacent to the hole is entirely filled and circulation is regained. The hole can then be drilled through the anhydrite.

When drilling through the salt is with ordinary fluid, fishing jobs are a very frequent occurrence, and operators use a mud fluid of such salinity that the cuttings are dissolved without at the same time causing the upper salt walls to be excessively enlarged.

Straightening crooked holes in salt is performed by cementing the hole back up to the point where it commenced to go crooked and then carefully redrilling with little weight on the bit. If the hole still persists in the crooked direction the next step would be to ream the hole to enable the stem to hang vertically by gravity and then to drill with light weight.

After passing through the salt the mud flush must be carefully watched so that when drilling into the unconsolidated sedimentary formations below, the walls are not broken down by the salty mud. A small amount of bentonitic compound should be added to improve the condition of the mud.

L. V. W. C.

407. Corrosion of Production Equipment in the Gulf Coast. S. Gill. *Oil Weekly*, 20.3.33, **69** (1), 51.—Corrosion of well equipment constitutes one of the most serious items of trouble and expense in the Gulf Coast area.

The most generally corrosive fields are those where the water-oil ratio is very high and the waters carry high concentrations of hydrogen sulphide.

Freedom from hydrogen sulphide, however, is by no means to be considered as indicating freedom from corrosion. In one field chemical analysis indicates that the waters are entirely free from hydrogen sulphide, and yet corrosion is serious.

In the non-corrosive areas it is generally true that little or no corrosion is experienced in the early years of the field due only partially to the relation of corrosion to the water-oil ratio. Usually, however, in the Coastal Fields, where the waters are free from hydrogen sulphide, no serious corrosion is to be expected before the fields are from four to seven years old, after which time increasing corrosion difficulties may be expected.

Well screens suffer most seriously from corrosion, and the cost of such corrosion can scarcely be evaluated. This corrosion is of two types:—(1) that experienced in the sulphide fields, which results in deposition of copper sulphide and other products of corrosion upon and within the screen, thus preventing ingress of fluid; (2) that form which results in the destruction of the strainer metal. This destruction permits sand to enter the well and cause sanding up with the resultant necessity of continually washing down the well. The remedy for the second type of corrosion is to use corrosion-resisting metals in the manufacture of screen pipe.

Tubing corrosion is very widespread in the fields of the Gulf Coast, but this can be reduced by the use of corrosion-resisting ferrous materials.

Corrosion of sucker rods causes greater loss than does that of almost any other item of oil well equipment. Even slight corrosion attack may be sufficient to reduce the resistance of the highly stressed steel to fluctuating loads. This results in what is known as corrosion fatigue, and the only methods of combating this is attention to the pumping loads, speeds, counterbalancing, etc.

In a similar manner the working barrels, balls and seats are corroded, and although the direct losses are slight the losses due to leakage may be considerable.

Surface equipment is subjected to rapid deterioration due to atmospheric corrosion, but proper painting will prevent this to a considerable extent.

L. V. W. C.

408. Casing Cementing Device Prevents Channelling. Anon. *Petr. Eng.*, March, 1933, **4** (6), 54.—A simple and effective device designed to prevent channelling has recently been successfully tried out. It consists of a rubber strip of triangular cross-section backed by a metal strip, by means of which it is tack-welded to the outside of the casing. Instead of the rubber strip being wound around the outside of the casing in a continuous spiral, the spiral is staggered at 7 ft. intervals between couplings on the joint of casing. The cement is thus deflected on its way up the annular space around the casing and thus channelling is prevented. L. V. W. C.

409. Control of High Pressures in Drilling. E. P. Hubbard. *Oil Weekly*, 20.3.33, **69** (1), 35.—One of the first steps in the analysis of pressure control is to estimate the pressures to be normally expected, and in cases where the formation pressure is greater than the pressure exerted by a column of liquid in the hole the mud should be of sufficient weight to overcome these formation pressures.

Proper conditioning of the drilling mud is one of the major factors leading to the successful completion of the well. Velocity of flow, viscosity and the colloidal quality of the mud are the important characteristics to be considered, since they affect the carrying capacity. A properly conditioned mud will also seal off the water-bearing formations and reduce the filtration

of water with its resultant thinning and weight reduction. If the properly conditioned mud is unable to overcome the pressures encountered, the weight may be increased by the addition of materials of higher density than found in drilling mud clays. Care must be taken when using these weighting materials to prevent too rapid unbalancing of the fluid columns. Precipitation is much more probable, and to counteract this property the colloidal characteristics of the mud should be properly maintained.

When high pressures are encountered unexpectedly and sufficient time is not available to recondition the mud to control the pressures, blow-out preventers are used. These preventers may be of two types, ram or bowl. In the ram type a specially prepared packer is forced around the drill-pipe, and in the bowl type the packing assembly latches around the drill stem.

During drilling the hole should be kept filled with mud at all times and particular attention to this is necessary when removing drill-pipe from the hole. The string should be removed slowly to prevent any likelihood of a swabbing effect, and the displacement of a considerable head of fluid. When drilling in high pressure formations the hole should be maintained as large as possible to minimise these hazards.

Prior to the setting of the screen pipe the hole should be conditioned to ensure the uninterrupted progress of the setting job.

The control of high pressures has been made much easier, and improved methods have considerably reduced most of the normal hazards.

L. V. W. C.

410. Chemically Treated Drilling Fluid. W. A. Sawdon. *Petr. Eng.*, March, 1933, **4** (6), 28.—The chief objective in applying chemicals in the control of mud fluids is to obtain an ideal drilling fluid, and since this ideal will differ for different wells, the chemical introduced must be of a character and amount best suited to the conditions encountered.

The troubles present in the deep wells can be assisted or even completely overcome by the use of proper drilling fluid, and prevention, rather than expensive repair work, should be the aim of chemically treated drilling fluid.

The chemicals used aim to stimulate the colloidal properties of the mud fluid as well as to fill, bond and seal all cracks and cavities as the well is drilled through the different formations.

Lost circulation can often be recovered by the use of chemically-treated drilling fluid, and if sufficient time is allowed to lapse large cavities can be completely filled.

L. V. W. C.

411. Hints of Practical Value. L. G. E. Bignell. *Oil and Gas J.*, 16.3.33, **31** (43), 33.—In districts where the only water available is salty and clays, that are easily accessible, contain up to 2% of salt, the mud flush is seriously lacking in colloidal properties due to the precipitation of the colloidal materials.

This salty clay can be treated satisfactorily at the well by the proper use of hydrated lime (calcium hydroxide) or caustic soda. Such treatment has been found to be economically practicable.

L. V. W. C.

412. Effect of Sand Tamping on the Efficiency of Explosives in Oil Well Shooting. Anon. *Petr. Eng.*, March, 1933, **4** (6), 26.—A quantity of nitroglycerin produces more than 700 times its own volume of permanent gases at normal temperature, but because of the extremely high temperature at the moment of explosion, these gases are greatly expanded and occupy a much larger space. A fluid column with only its gravity and frictional resistance cannot completely hold these pressures and the fluid moves up the hole at high velocity and with consequent absorption of power. The

disruptive effect is of sufficient intensity to damage either the walls or casing in the hole, resulting in cleaning out jobs.

Fluid stemming has been used almost universally, but as a result of investigations it has been discovered that solid stemming is more effective. Sand tamped shots have been experimented with, and the available data indicates that with sand tamping properly applied it is possible to shoot within a few feet of the pipe without serious danger of injuring it or its seat provided that all fluid is first carefully removed to a level below the casing seat and the bottom of the bridge. If it is impossible to remove all fluid from the hole, sand stemming can still be made effective by confining the sand column below the casing seat and by placing an additional 10 ft. of broken brick on top of the sand.

The sand bridge is placed after the bomb has been landed. After the sanding has been completed, the volume of gas coming from the hole should be carefully observed since any appreciable increase in gas volume would indicate that the shot has exploded. L. V. W. C.

413. Drilling and Producing Conditions in the Conroe, Texas, Field. K. C. Sclater. *Petr. Eng.*, March, 1933, **4** (6), 22.—The proven productive area in this field is now more than 15,000 acres, and the oil horizon is about 200 ft. below the top of the Cockfield formation in the Claiborne series. This formation has an average thickness of 56 ft. and an average porosity of 26%. The depth to the Conroe sand varies from 4855 to 5219 ft. throughout and. the surface elevations in the field range from 130 ft. to 220 ft. with 165 ft. as the probable average elevation above sea level.

The difficulties of drilling are not great except for the control of high pressure gas, and rotary is used exclusively.

In that part of the field, where blow-outs have occurred, three strings of casing must be set and cemented, and to overcome cratering tendencies the depth of the intermediate string has been increased from 900 to 1400 ft.

About 350 ft. of surface pipe is set and cemented and to keep back the water sands found down to a depth of 1200 ft. an intermediate string 1400 ft. long is set. Three casing programs are in general use by the major operators in the field, and strict regulations are in existence.

Close control of the mud is practised and blow-out preventers are supplied for both the surface pipe and the oil string, one preventer being of the hydraulically operated type, and the other of the regular type.

The surface formations in the Conroe field are very poor in mud-making qualities and commercial clays are generally used in starting the well. After a depth of about 900 ft. has been reached a satisfactory drilling mud of low viscosity and good colloidal properties is obtained. Below a depth of 3600 ft. the mud weight decreases, but the viscosity and the colloidal properties increase. This condition necessitates the exercise of extreme care.

Coring practice in the field is not uniform, but proper well completion would seem to demand a certain amount.

Wire wrapped screen is used in all wells and tubing is run to the top of the sand. The wells are washed out with clear water, swabbing being resorted to only if the wells will not flow.

All wells in the field are produced by natural flow with a reservoir pressure of about 2000 lb./sq. in.

The main producing horizon has a water drive as well as a large free gas cap and, since the sand is relatively permeable, close control of the water drive and conservation of gas in the field must be maintained. L. V. W. C.

414. New Production Methods. L. E. Smith. *Nat. Petr. News*, 15.3.33, **25**, (11), 45.—The principle changes that have occurred in the Pennsylvania fields are, wide spacing of wells, delayed drilling of oil-producing wells, lowered labour costs, use of seamless tubing, application of protective coatings to water lines and tubing, and a trend towards electrification of producing properties.

Mining for oil holds great possibilities in a number of areas, even in the Bradford-Allegany area after the producing sand has been completely filled with water.

Heating the oil sand to a high temperature, distilling the oil in the sand and recovering it in the form of condensible gas from a nearby well has been tried in West Virginia, and is believed to have possibilities.

The use of chemicals has been tried, but the results have not been satisfactory.

Variations in well spacing have taken place since water flooding was placed upon a proper footing, and the schemes now adopted are the "five" and "seven-spot" methods. In the "five-spot" method, four water wells form the corners of the square and one oil well in the centre of the square is the outlet for the oil.

Modification and improvements in the flooding methods will occur and serious consideration is being given now to the introduction of gas ahead of the water. It is believed that greater recovery will be obtained from this.

L. V. W. C.

415. Some Operating Problems of the Coastal Salt Dome Fields. R. G. Gray. *Oil Weekly*, 20.3.33, **69** (1), 43.—The pinching back of flowing wells on a salt dome is believed by some to result in irreparable damage, but such a belief is not strictly correct, since no two domes are the same, and hence the results of pinching will not be the same.

The reason why the flow of oil from these wells is restricted may be summarised as follows: (1) Because of sand conditions; (2) to control water; (3) to conserve gas energy.

Experience has shown that the manner of completing wells, size, mesh of screen, rate of flow, etc., depends entirely upon the conditions present in the particular well, and each well will present its own peculiar problem.

About 50% of the oil produced from this salt dome area is coming from the older fields, and these fields present real problems. The operation of small pumping wells in the Gulf Coast is extremely expensive due to loose sand and acid water conditions, which result in excessive wear on the pumping equipment. The abandonment of the non-paying wells has enabled operators to cut labour and total operating costs by a considerable amount, and thus permit the other wells to work at a more economical rate.

Repressuring of the lenticular sands overlying the salt has been practised with good results.

L. V. W. C.

416. Patents on Drilling Apparatus. L. J. Black. U.S.P. 1,899,922. 7.3.33.—Blow-out preventing attachment for casing heads.

W. D. Davidson. U.S.P. 1,899,946, 7.3.33. Kelly bushing.

E. W. Goeser. U.S.P. 1,899,953, 7.3.33. Rotary draw works with adjustable jack shaft.

T. G. Taylor. U.S.P. 1,900,029, 7.3.33. Drilling apparatus having a stationary stem and bit rotated by motor.

D. Dana. U.S.P. 1,900,163 and 1,900,164, 7.3.33. A method and apparatus for drilling oil wells, comprising the drilling of a large diameter hole to a shallow depth, and then landing a partitioned conductor pipe, enabling a number of smaller diameter holes to be drilled from the same spot.

D. J. Conant. U.S.P. 1,900,226, 7.3.33. Well reamer.

W. D. Shaffer. U.S.P. 1,900,260, 7.3.33. Multicap casing head.

N. K. Smith. U.S.P. 1,900,371, 7.3.33. Tubing catcher.

S. Robichaux. U.S.P. 1,900,618, 7.3.33. Liquid sample taking device.

G. A. Humason and W. A. Raymond. U.S.P. 1,900,714, 7.3.33. Tubing head.

J. H. Hallestelle. U.S.P. 1,900,932, 14.3.33. Rotary well drilling bit control.

G. A. Humason. U.S.P. 1,901,031. Well pumping apparatus.

G. Battelle. U.S.P. 1,901,141, 14.3.33. An apparatus for recovering oil comprising a non-leaking well casing with a seal placed above the oil-bearing formation inside the casing. A discharge tube, surrounded by a heat insulating and compression casing, is run into the casing and extends through the seal from top to bottom of the well. A valve operated by the pressure in the compression casing is placed at the top of the discharge tube.

L. A. Bond. U.S.P. 1,901,431, 14.3.33. A heat sensitive element is lowered into the rat hole at the bottom of the well, and the temperature to which this element is subjected is recorded.

L. C. Kelly. U.S.P. 1,901,453 and 1,901,454, 14.3.33. Whip stock and method for cementing whip stocks in wells.

G. G. Harrington. U.S.P. 1,901,643, 14.3.33. Drilling bit.

M. O. Johnson. U.S.P. 1,901,813, 14.3.33. Oil well testing device.

J. S. Abercrombie. U.S.P. 1,901,854, 14.3.33. Whip stock.

A. J. Penick and K. T. Penick. U.S.P. 1,902,097, 21.3.33. Blow-out preventer.

M. J. Lewis. U.S.P. 1,902,174, 21.3.33. A reamer connected to a bit by means of a universal joint used for straightening crooked holes.

S. W. Traylor. U.S.P. 1,902,296, 21.3.33. By variations in the hydrostatic pressure of the liquid in the well, a passage in a delivery conduit is opened and closed regardless of gas pressure, thus maintaining a liquid level, on the outside of the conduit, above the highest point of the entry of liquid into the conduit.

A. R. Weis. U.S.P. 1,902,431, 21.3.33. Leak proof upper main bearing for deep well turbines.

C. C. Brown. U.S.P. 1,902,540, 21.3.33. Well control device.

L. V. W. C.

Class 400. Transportation, Storage and Distribution.

417. A.P.I. Pipe Coating Tests. Progress Report No. III. G. N. Scott. *A.P.I. Production Bull.* 210, p. 114 (1932).—The 1932 Progress Report to the A.P.I. Committee on Corrosion of Oil Field Equipment covers: (*a*) The second inspection of pipe coating tests on operating lines, and (*b*) initial inspection of short-coated specimens.

(*a*) The A.P.I., in conjunction with the U.S. Bureau of Standards and manufacturers of coating materials, is carrying out a series of field tests under actual operating conditions to investigate the production of underground pipe-lines against corrosion. In 1930, 15 sites were selected in 8 states and 19 different protective coatings, varying in composition, structure and thickness—were distributed among the sites and applied to the working lines. In the 1931 Progress Report on A.P.I. coating tests (A.P.I. Production Bulletin No. 208, p. 55 (1931)), various methods of test were devised and applied to the first series of inspections made on part of the coating.

The present report describes the visual examination of the degree of corrosion in the pipes examined and presents data on the electric conductance and the pattern tests applied.

In general, the electric tests were in good agreement with the condition of the pipe. In the case of a coating composed of an asphalt emulsion, followed by a rigid shield of sand and cement mortar, the conductance appears to depend partly on the amount of moisture absorbed by the concrete, but as yet no obvious relation between the amount of moisture absorbed and corrosion has been noted. The coating does not give a positive pattern, even with a high conductance, unless a break in the coating occurred. In the case of an asphalt cut-back with primer and coat of asphalt adhesive finished off with aluminium foil, the latter was invariably found in contact with the pipe so that conductances above the range of the instrument were found. Positive patterns were obtained where no corrosion was found.

Coatings which had been in service for some time and which have conductances of 10 micromhos per sq. ft. have given nearly perfect protection, while of those with conductances of 10–40 micromhos, less than 50% show corrosion which is only of a mild nature. When the conductance is greater than 40 micromhos the pipe is most likely to be corroded, but the extent will depend on the corrosiveness of the soil and structure of the coating rather than on the conductance. For re-inforced coatings the upper limit of conductance can probably be extended to 100 micromhos.

The results of corrosion tests of uncoated pipe are also given for comparison.

(*b*) Similar tests were carried out on short-coated specimens of pipe, the results being in generally good agreement with those of the operating lines. Full descriptions of the coatings, their condition and the results of the conductance and electrical pattern tests are presented in tabular and graphic form.

It is hoped to present shortly a detailed study of the data with an interpretation of the relative merits of the coatings or groups of coatings.

C. L. G.

418. Pipe Line Station Water Cooling Systems Utilizing Crude Oil. J. M. Totten. *Petr. Eng.*, March, 1933, **4** (6), 44.—A popular jacket water cooling system for oil pipe line service consists of a shell and tube exchanger located in the oil line on the suction or discharge side of the main line pump, a water circulating pump, suitable piping and a surge tank.

In most cases the oil is passed through the tubes of the exchanger, the jacket water being pumped through the shell, thence to the prime mover jacket and from there to the surge tank. Flexible couplings on the oil and water connections possess advantages.

In the earlier installations the coolers were made on the suction side of the main pumps, but the tendency at present is to locate them in the discharge line. By doing this there is no possibility of vaporization in the cooler, even with the lightest crudes and in addition the pumps can be relied upon to fill properly. A higher pressure drop on the oil side of the cooler can be allowed, which results in a smaller cooler for a given capacity. Where an oil tends to deposit paraffin in the coolers there is far less likelihood of this happening when the cooler is placed on the discharge side.

During the winter months not all the crude oil is needed to cool the jacket water, and some is therefore by-passed around the cooler. L. V. W. C.

419. Nomograph for Gas Flow in Pipes. T. Makamura. *J. Fuel Soc., Japan*, 1933, **12**, 25.—The following formula is stated to be widely adopted in connection with the distribution of coal gas to give the loss of pressure of fluid flowing through a pipe :—

$$Q = \frac{1}{600}\sqrt{\frac{d^5h}{sl}} \text{ or } d^5 = \frac{(600\,Q)^2sl}{h} = \frac{H^2sl}{49h}$$

where Q = vol. of gas in cu. m. per hr., d = internal dia. of pipe in mm., l = length of pipe in M, s = sp. gr. of gas (air = 1), h = loss of pressure in mm. and H = heat quantity distributed in cals. per hr. As it is frequently inconvenient to obtain any one value from the five variables of the formula by calculation or by the use of a numerical table, the author has drawn a nomograph for this purpose. The five variables are classified into three groups : h.s.t.$_1$, $t_1$lt$_2$ and d H or Qt$_2$, which are connected to form a convenient diagram by means of the intermediate variables t_1 and t_2. In addition, a nomograph has been devised to give the number of pipes of smaller diameter corresponding to a main pipe. For this purpose the following formula was used :—

$N = \left(\frac{D}{d}\right)^{\frac{5}{2}}$ where d = dia. of the smaller pipe, D = dia. of main pipe, and N = number of smaller pipes. W. H. T.

420. Theory of Oil Sampling from Tanks. J. K. Figlmüller. *Petr. Zeit.*, 15.1.33, **29** (11), 8–11.—This article deals with the sampling of crude oils from tanks containing sediment up to 10% by volume. Several formulæ are derived showing the relationship between the volume of oil, percentage of impurities, dimensions of the cylindrical tank and the height of the column of sediment. W. S. E. C.

Class 500. Properties and their Determination.

421. A. Angstrom's Total Immersion Hydrometer. P. F. Gaehr. *Rev. Sci. Inst.*, 1933, **4**, 138.—The total immersion hydrometer has the appearance of an ordinary hydrometer inverted, the narrow stem containing some ferrous material and the wider portion serving as buoy. In use, the hydrometer is pulled down to a definite position by the field of a solenoid coaxial with the hydrometer jar and the current necessary to do this is related to the specific gravity of the liquid. This paper is an account of a critical study of the instrument with regard to the design of solenoid and core, magnetic behaviour, sensibility and calibration. It is suggested that choice and weight of ferrous material for the core is of importance, and in this connection Permalloy is recommended. On the other hand, if this material is not used, a mixture of D.C. and A.C. is recommended for producing the magnetic pulls, only the D.C. being measured. Equations in connection with the calibration are given. W. H. T.

422. Beneficial Effect of Oxidation on the Lubricating Properties of Oil. R. O. King. *Proc. Roy. Soc.*, 1933, **A139**.—Earlier workers on the nature of journal-bearing lubrication having conducted their experiments in conditions such that oxidation of the lubricant was precluded, the author, in view of the fact that oxidation is inevitable in the usual operation of internal combustion engines, has investigated the possibility of boundary conditions arising as a result of oxidation of the lubricant. With this object in view the experiments were carried out with a journal-bearing machine of the Thurston type as designed by Jakeman for Stanton's investigations, and operated

under conditions such that the oil was subjected to active oxidation during use. In this machine a hollow 2 in. dia. nickel-chrome steel journal, heated by an internal gas burner, is supported on bronze bearing bushes 2¼ in. in length. As the experiments were mainly concerned with the lubricating value of oil in extreme conditions of use, i.e., a heavy load and high temperature, and the film between lubricating surfaces becoming extremely thin with seizure imminent, particular attention was given to the state of the surfaces at the commencement of a run. The journal was lapped and polished after a smooth lathe finish, and the bronze bushes were used with various types of surface finish.

All the experiments were made at a constant rubbing speed of 11·3 ft. per sec. and a constant loading of 1000 lb. per sq. in. Bushes set with a clearance of 0·0075 in. and an arc of wear of 80° to 100° after the " running in " period, were rejected when the clearance had increased by 0·012 in. and the arc of wear extended beyond 120°. The bearing was lubricated by force-feed from a two-gallon sump, a circulatory system being used, the oil being returned to the sump counter current to the oxidising action of a stream of hot air. The temperature of the oil film during a run was measured by means of a thermocouple set into the upper bush, and was allowed to rise as long as any marked change in friction was observed and seizure occurred. The performance or useful lubricating value of a particular oil in the circumstances was taken to be indicated by the coefficient of friction at the temperature of minimum friction, and the somewhat higher temperature, designated (u min.) and (ST) respectively, at which, owing to a further decrease of film thickness, seizure actually occurs and throws the belt off the flat-faced driven pulley.

In the case of all the oils examined friction was observed to decrease as the temperature rose and to pass through a minimum value (u min.) at a temperature rather less than that at which seizure occurred (ST). As an example, a typical blended mineral oil with values of u min. = 0·001 and ST = 158° C. when fresh, showed a progressive improvement during 60 hrs. service to u min. = 0·00045 and ST = 309° C. It was demonstrated that this improvement was not due to any improvement in the state of the bearing surfaces during the run by replacing the oil in circulation by a fresh sample, when a process of improvement began anew. The increase of viscosity known to accompany oxidation leads necessarily to an increase of friction in the fluid part of the oil film, the decrease in friction observed must arise from a change of boundary conditions effected by oxidation and is greater than the increase of fluid friction due to viscosity increase.

It is suggested that the active or polar molecules formed during the early stage of oxidation build up to an appreciable thickness on the absorbed layer and the friction observed is that on the surface of the built-up layer. The surface diminishes in rigidity in the direction of motion as the thickness of the boundary layer increases and friction approaches zero as a surface of complete slip tends to be reached. S. B.

423. Road Tests Conducted on Lubricating Gasolines. A. L. Foster. *Nat. Petr. News*, 1.3.33, **25** (9), 26–32.—An investigation has been undertaken with a fleet of road cars on the behaviour of a variety of lubricants, added in turn to a standard non-premium gasoline. The lubricants used comprised proprietary top-cylinder lubricants and straight lubricating oils. The test cars were equipped with temperature controlling and recording devices, and road speeds and wind speeds and compression pressures were recorded systematically. A series of photographs give the appearance of one piston head and combustion chamber before and after the test run of 500 miles over representative country. Periodic analyses were also carried out on the

exhaust gases. A table gives the data appertaining to each test. An examination of the photograph shows that a considerable deposit of carbon was produced in each case, and a photograph taken after a run on untreated gasolines affords some means of comparing these deposits. In a particular case, an alleged remover of carbon deposit would appear to be inefficient. Graphs are shown giving the fuel consumption when running on treated and untreated gasoline respectively. The advantage appears to be slightly in favour of the use of a lubricant. One photograph shows the appearance of the cylinder head of a new engine after running 3100 miles on treated gasoline. There would appear to be a considerable deposit of carbon. H. G.

424. Platinised Silica Gel as an Oxidation Catalyst in Gas Analysis. K. A. Kobe and E. J. Arverson. *Ind. Eng. Chem., Anal.*, 1933, **5** (2), 110–2.—This part deals with the oxidation of hydrogen and carbon monoxide and investigates the utilisation of platinised silica gel as an oxidation catalyst in gas analysis. The platinised silica gel contained 0·075% platinum and was sieved to pass 14 mesh and retained on 20 mesh.

(1) *Determination of hydrogen.* — A mixture of hydrogen, oxygen and nitrogen was prepared and analysed by the explosion method. Using the catalytic method, in which the U.S. Steel Corporation gas apparatus was employed, gave similar results with complete oxidation of hydrogen after four times passage through the catalyst tube at 125° C. This is a great advantage over the copper oxide method, where a temperature of 300° C. is required.

(2) *Determination of carbon monoxide.*—It was found necessary to raise the heater temperature to at least 300° C. in order to oxidise the carbon monoxide. A much faster rate of flow of gas is possible with this method than that in the copper oxide method.

It is found that at low temperatures (100° C.) carbon monoxide acts as a catalytic poisoner, but is completely oxidised on heating to 300° C.

Conclusions.—(1) Hydrogen is quantitatively oxidised by oxygen over a commercial platinised silica gel at a temperature of 100° C.; (2) carbon monoxide is a catalyst poison at 100° C., but is oxidised at a temperature of 300° C., the catalyst being completely reactivated. Mixtures of hydrogen and carbon monoxide can thus be oxidised at 300° C.; (3) hydrogen in a hydrogen-hydrocarbon mixture may be determined by fractional combustion with oxygen by passing the gases from four to six times at a rate of 30 to 50 c.c. per minute over the catalyst at a temperature of 100° C. R. E. D.

425. Errors in Open-Cup Flash-Point Determination. A. Baader. *Erdöl u. Teer*, 1933, **9**, 140–142, 155–157.—The conventional open-flash point method and the D.V.M. proposals are criticised. Errors are introduced by several factors, viz., cooling of the oil vapour between its formation and its ignition by the test flame, disturbances due to air currents in the laboratory, and variations in the air or oxygen supply.

The errors caused may be quite large and seriously detract from the value of the results obtained.

The author proposes to obtain true flash-points by means of an apparatus with a closed cup, a regulated and warmed supply of oxgyen or air and electrical instead of gas heating. Ignition is by means of an electrically heated white-hot platinum wire.

Finally, comments are made on the recently published article by Erk (*cf.* Abs. 335/1933). E. B. E.

426. Thermal Decomposition of Simple Paraffins. F. E. Frey and H. J. Hepp. *Ind. Eng. Chem.*, 1933, **25**, 441.—The primary thermal decomposition reactions of n-butane, isobutane, n-pentane, isopentane, 2, 2-dimethyl. propane, 2, 3-dimethylbutane, and n-hexane were studied by decomposing each hydrocarbon to a moderate extent only, and analysing the products completely.

Details are given of the apparatus, source and purity of the hydrocarbons, and the analytical methods used.

With propane, n-butane and isobutane at 575° C. decomposition produces olefines and the complementary paraffins (at the limit, hydrogen). From n-butane all three normal butylenes were obtained. Isobutylene and methane were virtually the only products from dimethylpropane. In the case of isopentane the authors concluded that the carbon-carbon bonds in all positions break to form complementary product molecules under conditions which preclude the decomposition of normal primary products by ordinary secondary decomposition. With dimethylbutane, severing of the outer bonds to produce methane and trimethylethylene and of the middle bond to produce propane, propylene and hydrogen are apparently the chief primary reactions. The decomposition of n-pentane and n-hexane was exceptional in that equal amounts of complementary products were not formed. This behaviour is in agreement with a chain-reaction mechanism involving the formation and subsequent decomposition of free alkyl radicals. If all radicals larger than ethyl are assumed to decompose the mechanisms reduce to give the following net results :—

n-pentane :

$$C_5H_{12} \rightarrow C_3H_4 + C_2H_4 + CH_4$$
$$C_5H_{12} \rightarrow C_3H_6 + C_2H_6 \text{ (or } C_2H_4 + H_2)$$
$$C_5H_{12} \rightarrow C_4H_8 + CH_4$$

n-hexane :

$$C_6H_{14} \rightarrow C_3H_4 + C_2H_4 + C_2H_6 \text{ (or } C_2H_4 + H_2)$$
$$C_6H_{14} \rightarrow C_3H_6 + C_2H_4 + CH_4$$
$$C_6H_{14} \rightarrow C_4H_8 + C_2H_6 \text{ (or } C_2H_4 + H_2)$$
$$\searrow C_5H_{10} + CH_4$$

At lower temperatures there are indications that n-pentane and n-hexane approach more closely, in the manner of their decomposition, to the lower paraffins.

Where olefines capable of existing in isomeric forms were produced, the double bond remained at the point of rupture. 2-Butylene was found in both isomeric forms. The normal paraffins produced only 1-olefines. In the case of scission of a side chain as with isopentane and 2, 3-dimethylbutane the double bond at the point of rupture was located in the inner and not the terminal position.

For isopentane the reaction velocity constants, in the range 400 to 575° C., are in agreement with the equation :

$$\ln k_1 = 29{\cdot}95 - \frac{59{,}000}{R\,T}$$

where the heat of activation is 59,000 calories per gram mol. Velocity constants are given for the other hydrocarbons at 425 and 575° C.

E. N. H.

427. Anti-Knock Research Co-ordinates Laboratory and Road Tests. C. B. Veal, H. W. Best, J. M. Campbell and W. M. Holaday. *J.S.A.E.*, **32**, 105–120.—This paper is a very complete account of the development of the now practically universally adopted method of rating automobile fuels

known as the "C.F.R. Motor Method." A full description of the technique developed for tests of fuels in a large number of cars on the road is given, together with results obtained. These showed discrepancies with the older laboratory test method known as the "Research Method," and an account is given of the laboratory work at the Waukesha Motor Works, where the Motor Method was evolved, using the same fuels as for the road tests. The article gives illustrations of details of the C.F.R. engine, and an appendix gives details of recommended practice for conducting road tests, which has been officially approved by C.F.R. Committee and which should be of considerable value to anyone undertaking such tests. C. H. S.

428. Flame Temperatures of Combustible Gas-Oxygen Mixtures. H. H. Lurie and G. W. Sherman. *Ind. Eng. Chem.*, 1933, **25**, 404.—The literature and theory of flame temperature measurement are briefly reviewed. The combustion mechanism is discussed.

For the determination of flame temperatures a Leeds and Northrup optical pyrometer of the disappearing filament type was used. This instrument was calibrated with a dark glass of known absorptive co-efficient in front of its telescope. The measurements made covered the range from excess combustible gas to excess oxygen and curves are given correlating gas composition with flame temperature.

The maximum flame temperatures in ° K are:—Acetylene, 3410; hydrogen, 2933; City gas (550 B.Th.U.), 3030; natural gas (1025 B.Th.U.), 3290; mixed natural and coke-oven gas (808 B.Th.U.), 3180; mixed natural and carburetted water gas (800 B.Th.U.), 3180. The vol. composition of mixtures giving maximum flame temperature are acetylene 42·5%, oxygen 57·5%, and hydrogen 78%, oxygen 22%.

Calculations of the flame temperatures, based on references given by the authors, are included for comparison with the experimental data. E. N. H.

429. Control of Combustion of Mixed Fuels by Flue Gas Analysis. M. J. Burkhard. *Petr. Eng.*, March, 1933, **4** (6), 62.—The amount of excess air required for the combustion of any of the usual refinery fuels, including still gases, fuel oil, pulverised coke, waste sludge and slops, and even pulverised coal, can be calculated from the Orsat volume percentage analysis of the flue gases using a modification of the formula originally presented by the Bureau of Mines, viz.:—

$$\% \text{ excess air} = \frac{N_2 \times 100}{N_2 - 3{\cdot}78\ O_2 + 1{\cdot}89\ CO}$$

The formula cannot be applied to fuels containing CO_2, CO or free O_2 and N_2, but such fuels are not likely to be met with in a refinery, with the exception of fuel gases from a vapour recovery plant, which usually contain air.

The method of using the formula from the Orsat analysis of flue gases is described, and a graph reproduced giving the amount of excess air directly ascertainable from the volume percentages of the different gases. C. L. G.

430. Infra-Red Radiation from an Otto Cycle Engine. Part I. Apparatus and Technique. S. Steele. *Ind. Eng. Chem.*, 1933, **25**, 388.—This is the first of a series of papers describing an investigation of infra-red radiation from the cylinder of an Otto cycle engine.

A single-cylinder engine having a bore of 9·53 cm. and a stroke of 10·2 cm. was used.

Quartz is not suitable for use as a window in infra-red research since it cuts out all of the most important carbon dioxide band at wavelength

4·4 μ, as well as the smaller bands, greater than 5 μ, due to water vapour. Fluorite windows were therefore prepared from polished plates 3 mm. thick and supported by rubber-asbestos washers in nickel plugs. Thirty-one positions were available in the cylinder head, each of diameter 3 mm., and each giving a view of a small depth of charge in a direction approximately perpendicular to flame travel. A fan-cooled transite shield was arranged about 2 cm. above the engine head so that a small hole in the screen came directly above the window in use. An electromagnetically operated shutter was fitted to the shield enabling zero and radiation readings to be taken alternately. The radiation was focussed by a system of surface-silvered mirrors, first on the slit of a stroboscope, and finally on a sensitive single-junction antimony-bismuth vacuum thermocouple. The e.m.f. generated was measured on a specially mounted Thomson galvanometer. The stroboscope consisted of two rotating discs driven from the engine crank shaft and giving a maximum possible range of slit opening equivalent to 20° of crank-shaft angle. Using the Thomson galvanometer, it was possible to obtain a large deflection with an opening equivalent to 1° of crank angle, but since, for any given window, the first appearance of flame varied as much as 2° of crank angle, there was no reason to reduce the opening below 2°.

Pressures in the engine cylinder were measured by a balanced-pressure diaphragm indicator, and for every radiation measurement a corresponding measurement of pressure was obtained.

Curves are given showing the effect on radiation of a Schotts red glass filter designed to cut out the carbon dioxide band at 4·4 μ, of change in window position and of variation in fuel-air mixture. The operating conditions, using benzole as fuel, were: jacket temperature 55° C.; speed, 600 r.p.m.

E. N. H.

431. Thermal Conductivity of Liquids. O. K. Bates. *Ind. Eng. Chem.*, 1933, **25**, 431.—A new apparatus, designed for the determination of true and average co-efficients of thermal conductivity and the temperature co-efficients of thermal conductivity of liquids over a temperature range by means of a single test, is described. The apparatus consisted of a hollow drum-shaped container, housing two horizontal circular plane faces 2 in. apart, the upper being electrically heated and the lower water-cooled. The liquid to be tested was passed between the two faces and all temperatures were measured by means of thermocouples. It is claimed that results obtained are accurate and that convection effects between the plates, suitably heated and properly guarded, is negligible as regards transmission of heat through the liquid. A surface effect is present at the interface of a stationary liquid and a solid during the transmission of heat normal to the interface. This effect is not to be confused with the usual film effect encountered with moving fluids.

W. H. T.

432. Determination of Paraffin and Naphthene Content of Gasolines. C. C. Minter. *Nat. Petr. News*, 22.2.33, **25** (8), 25–27.—A method is described which is stated to supersede the aniline point method for the determination of naphthene and paraffin content of a gasoline. For purposes of illustration, it is assumed that, after the removal of aromatics and unsaturateds by acid washing and the subsequent distillation of the acid-washed gasoline, the distillate consists of a mixture of paraffins and naphthenes, whose mean boiling point corresponds to the 50% boiling point on the A.S.T.M. distillation curve. It is further assumed that the mean boiling point of the paraffins in the mixture is the same as the 50% boiling point of the gasoline, and similarly

for the naphthenes. Then if d = the specific gravity of the distillate from the residue from the acid wash, d_1 = specific gravity of the pure paraffin boiling at the 50% point of the gasoline, d_2 = specific gravity of the pure naphthene boiling at the 50% point of the gasoline, and p_1 and p_2 are the fractional percentages of paraffins and naphthenes in the distillate we have

$$d = p_1 d_1 + p_2 d_2 \quad \ldots\ldots (1)$$

Substituting $p_2 = 1 - p_1$, we have

$$p_1 = 100 \left(\frac{d_2 - d}{d_2 - d_1} \right) \quad \ldots\ldots (2)$$

$$p_2 = 100 \left[1 - \left(\frac{d_2 - d}{d_2 - d_1} \right) \right] \quad \ldots\ldots (3)$$

as the percentages of paraffins and naphthenes in the distillate.

Then if V is the sum of the volumes of the aromatics and unsaturateds removed, and p_3 and p_4 the percentages of paraffins and naphthenes in the gasoline,

$$p_3 = p_1 \left(1 - \frac{V}{100} \right) \quad \ldots\ldots (4)$$

$$\text{and } p_4 = p_2 \left(1 - \frac{V}{100} \right) \quad \ldots\ldots (5)$$

Substituting p_1 and p_2 from 2 and 3, we have

$$p_3 = 100 \left[\left(\frac{d_2 - d}{d_2 - d_1} \right) \left(1 - \frac{V}{100} \right) \right] \quad \ldots\ldots (6)$$

$$\text{and } p_4 = 100 \left[1 - \left(\frac{d_2 - d}{d_2 - d_1} \right) \left(1 - \frac{V}{100} \right) \right] \quad \ldots\ldots (7)$$

Since the specific gravities of the pure constituents having a boiling point corresponding to the 50% point of the gasoline will vary with the mean boiling point of the gasoline, we can express d_1 and d_2 in equations 6 and 7 as a function of the temperature.

Now $d_1 = 0{\cdot}6537 + 0{\cdot}000228\ T$

and $d_2 = 0{\cdot}7126 + 0{\cdot}000244\ T$

where T is the boiling point in °F. of the pure paraffin or naphthene. These represent approximately the variation of specific gravity with boiling point for the two series of hydrocarbons.

Finally we have

$$p_3 = \left(1 - \frac{V}{100} \right) \left(\frac{0{\cdot}7126 + 0{\cdot}000244\ T - d}{0{\cdot}0591 + 0{\cdot}000016\ T} \right) 100 \quad \ldots\ldots (8)$$

$$\text{and } p_4 = \left(1 - \frac{V}{100} \right) \left(\frac{1 - 0{\cdot}7126 + 0{\cdot}000244\ T - d}{0{\cdot}0591 + 0{\cdot}000016\ T} \right) 100 \quad \ldots\ldots (9)$$

A table is given showing the results given by the new method and by the aniline point method. Agreement is good in most cases, though a wide discrepancy occurs often. It is pointed out that the new method applies only to straight-run gasolines. H. G.

433. Polymerisation Products. R. Lespieau and I. Urion. *Kolloid Zeit.*, April, 1933, **63** (1), 84–87.—The preparation of divinylacetylene and 1·6 dimethylhexa 1.3.5 triene is described and their physical and chemical properties given. Liquid divinylacetylene yields spontaneously a solid gel which is slightly explosive and contains monomeric divinylacetylene. Crystallised dimethylhexatriene is converted into an elastic, rubber-like substance under the influence of oxygen. W. S. E. C.

434. Stirrer Drive for Laboratory Use. M. H. Hubacher. *Ind. Eng. Chem. Anal.*, 1933, **5** (2), 149.—This consists of a three or four step pulley attached to a vertical shaft holder of steel, provided with a collar for inserting glass stirrer and holding firm. There are two horizontal rods attached to shaft which can be clamped to give rigidity. This modification offers the following advantages: (1) Glass stirrers can be held firm without fear of breaking; (2) stirrer drive can be attached rigidly to a supporting stand. R. E. D.

435. Laboratory Esterifying and Fractionating Apparatus. C. A. Doran. *Ind. Eng. Chem. Anal.*, 1933, **5** (2), 101–2.—The apparatus described was designed with the object of duplicating plant conditions in a small laboratory equipment. In essence it consists of a kettle, fractionating column, dephlegmator and condenser. A vapour line and a separate reflux line are provided in connection with the kettle. The column, with glass beads or coarse carborundum as fractionating medium, is well insulated to prevent transfer of heat from liquid and vapours in column and so approach the conditions experienced in plant operation. Details of construction are given, the dephlegmator consisting of a short condenser with variable head of cooling liquid enveloping the topmost point of the vapour line from the fractionating column.

This apparatus is claimed to be very flexible in operation in the case of industrial solvents, plasticisers, etc., and simple of construction. R. E. D.

436. Laboratory Cooling Unit. D. H. Cook. *Ind. Eng. Chem. Anal.*, 1933, **5** (2), 147–8.—A small Frigidaire unit S was modified to fit into a tank, heavily insulated. This serves as a reservoir for the cooled water. With a tank capacity of 24 litres and the pump working at 750 r.p.m.—3·5 litres per minute of cooled water was available. In the normal operating range from 12° C. to 20° C. the unit will give the hourly equivalent of the melting of 4·8 kilograms of ice. It is asserted that efficient insulation and some other carrier than water temperatures below 0° C. might easily be attained. R. E. D.

437. Domestic and Industrial Fuel Oils. U.S. Bureau of Standards Commercial Standard CS12–29.—A general conference of refiners, distributors and consumers of fuel oil, manufacturers of oil burners and general interests was held on January 9th, 1929, to evolve specifications for domestic and industrial fuels oils. Tentative specifications proposed by the American Oil Burner Association with the co-operation of the A.S.T.M. and the A.P.I. were utilised as a basis. The final specifications evolved include three grades of domestic fuels, each a distillate oil, and 3 grades of industrial fuel. The general requirements for all grades demand freedom from water, acid, grit and foreign matter likely to clog or injure the burner or valves, and for grades 5 and 6, straining through special filters or wire gauzes of 16 meshes to the inch may be requested.

The grades are: No. 1, light domestic fuel; No. 2, medium domestic fuel; No. 3, heavy domestic fuel; No. 4, light industrial fuel; No. 5, medium

industrial fuel; No. 6, heavy industrial fuel. The main details of the specifications are :—

	Grades.					
	No. 1.	No. 2.	No. 3	No. 4.	No. 5.	No. 6.
Fl. Pt. ° F. ..	110/165	125/190	150/200	150 min.	150 min.	150 min.
Water and sediment (max.)	0·05%	0·05%	0·1%	1%	1%	2%
Pour Point ° F. (max.)	15	15	15	—	—	—
Visc. S. U. at 100° F. (max.) secs. ..	—	—	55	125	—	—
Visc. S. F. at 122 ° F. (max.) secs. ..	—	—	—	—	100	300
10% over at ° F. (max.)	420	440	460	—	—	—
90% over at ° F. (max.)	—	620	675	—	—	—
E. P. ° F. (max.) ..	600	—	—	—	—	—

The methods of test are those laid down either by A.S.T.M. or Bureau of Mines Technical Paper 323B.

The significance of each of the tests prescribed is outlined. R. A. E.

438. Gum Formation in Gasoline: I. Measurement of Gum Stability of Gasoline. T. H. Rogers, J. L. Bussies and P. T. Ward. *Ind. Eng. Chem.*, 1933, **25**, 397.—It is considered that the Voorhees gum stability test, which measures the oxidation behaviour of motor fuels at 100° C. in terms of an induction period, is a suitable method for predicting gum stability of these materials in storage. Expressed in terms of the time required to form 10 mg. of gum per 100 ml. of fuel, it has been found that an induction period of 400 minutes corresponds to six months' storage at 35° C. in a bottle or to a year of storage at atmospheric temperature in vented iron barrels, the gasoline being saturated with air. A diminished oxygen supply will ensure a certain degree of safety as regards quiescent tank storage, but it is pointed out that the protection afforded by a low oxygen concentration is not a practical insurance against gum formation. Under conditions of quiescent storage, the stability of gasoline is being constantly decreased with the possibility of oxidation under the more severe conditions of subsequent storage.

W. H. T.

439. Distribution of Gum Forming Constituents in Cracked Gasoline. S. M. Martin, W. A. Gruse and A. Lowy. *Ind. Eng. Chem.*, 1933, **25**, 381.—Gum stability (as measured by the oxygen-bomb method at low temperatures) of narrow-boiling fractions of a vapour phase distillate, has been studied, it being found that gum formation varies greatly from one fraction to another. Gum is formed in fractions boiling between 63° and 146° C., with larger amounts from those boiling between 74° and 79° C., 102° and 107° C., and 124° and 129° C. It is considered that this gum formation is due directly or indirectly to specific compounds, probably conjugated diolefines. Treatment with maleic anhydride, sulphuric acid or partial hydrogenation render the fractions stable to a 38° C. oxidation test, presumably by the removal of very reactive unsaturated hydrocarbons which form peroxides readily. It is probable that hydrogenation will convert all diolefines conjugated or unconjugated either to saturated compounds or to less reactive olefines and thence to saturated compounds. Maleic anhydride presumably will remove only conjugated olefines and sulphuric acid will certainly remove the latter

compounds, probably the unconjugated ones, and will affect the olefines and aromatics to a slight extent. When oxidised at a higher temperature, these treated materials give further amounts of gum, this formation being attributed to the oxidation of unsaturated hydrocarbons still present (*e.g.*, cyclic olefines). The gum figures obtained as a result of treatment at 50° C. show the maleic anhydride treated material to be the most unstable, and the hydrogenated fraction to be the most resistant to oxidation due to more complete removal of cyclic olefines. It is concluded that it is unlikely that highly cracked material can be completely stabilised by treatments which remove only small proportions of unsaturated bodies, leaving the remainder unchanged.

W. H. T.

440. Determination of Sulphur and Chlorine in Gasoline. C. Wirth and M. J. Stross. *Ind. Eng. Chem. Anal.*, 1933, **5** (2), 85–7.—In refining gasoline, metal chlorides are sometimes used which allow of chlorination of hydrocarbons. Thus sulphur content determined by lamp method may be in excess of actual sulphur content due to presence of hydrogen chloride in absorbed gases. The new procedure consists of two steps: (1) Determination of total acidity by burning gasoline in A.S.T.M. lamp; (2) Determination of chlorine content by Mohr's method.

The total acidity is a measure of the sulphur trioxide and hydrochloric acid formed by the combustion of the sulphur and chlorine containing hydrocarbon and is expressed as percentage of sulphur. The chlorine content with a suitable factor as determined by titration is subtracted from the total acidity. The true sulphur percentage is obtained by differences.

Procedure.—After burning in lamp, sodium carbonate solution is titrated with 0·0623 N. H_2SO_4 with methyl orange as indicator. Neutralised solution is then concentrated and titrated with 0·1 N. silver nitrate solution in the presence of a few drops of potassium chromate till a red coloration appears.

The end point as obtained by the sulphuric acid titration indicates the total acidity. Therefore the percentage of chlorine:

$$\% \text{ chlorine} = \frac{\text{ccs. } 0{\cdot}100\ N\ AgNO_3 \times 100 \times 0{\cdot}00355}{\text{grams sample burned.}}$$

The sulphur content is obtained by difference.

The method was tested out by obtaining data upon gasolines of known sulphur and chlorine content. The chlorine content was varied by addition of known quantities of chlorine derivatives of hydrocarbons chosen to include several types of chlorinated hydrocarbons.

Results show that: (1) presence of a range of percentages of chlorine from 0·017 to 0·390% does not affect the accuracy of the sulphur determination upon the samples of sulphur contents from 0·005 to 0·328%; (2) high sulphur gasoline does not burn readily in lamp; (3) excellent check results were obtainable using bomb method, determining sulphur by barium sulphate precipitation and the chlorine by silver nitrate titration; (4) variation in the type of chlorine compound present in the gasoline does not affect the accuracy of the determination.

R. E. D.

441. Investigation into the Plastic Properties of Asphaltic Bitumen. R. N. Saal and G. Koens. *J. Inst. Petr. Techn.*, 1933, **19**, 176–212.—An account of an experimental investigation on the plastic state of asphaltic bitumen. With the aid of modified forms of the capillary and the Couette viscometers, data was obtained from which certain conclusions regarding the plasticity of asphaltic bitumens were deduced.

G. R. N.

442. Evaluation of Asphalt-Bearing Stocks. W. L. Nelson. *Petr. Eng.*, March, 1933, **4** (6), 58.—The increase in the use of asphalt for road construction and in the range of straight and cracked stocks that have now been found suitable for the manufacture of asphalts has rendered the evaluation of such stocks of great importance. With a view to determining the suitability of a road oil prepared from any stock, a table is given showing the usual range of properties as required by the different state specifications (see also *J.I.P.T.*, 1932, Abs. No. 928). A table is also given showing the range of petroleum asphalt materials, as used for road, roofing and sealing purposes, with their penetration, ductility and melting point ranges. The general relation between the various tests for asphalt, *viz.*: (1) consistency or fluidity tests; (2) ductility; (3) boiling range or evaporation; (4) solubility test; (5) impurity tests, is discussed.

For evaluating the all-round value of a raw asphalt stock the following information should be obtained: (1) yields; (2) distillation curve; (3) flash vaporisation data if pipe still processing is proposed.

(1) A series of batch vacuum distillations covering a range of 25/200 Pen. at 77° F., or, if semi-solid asphalts are required, the float test from 20/100 at 122° F. should also be determined. Ductility and evaporation tests should also be carried out.

(2) The distillation curve is most useful from a design standpoint, but owing to the high temperature of distillation a vacuum 10% distillation conducted in a manner similar to the A.S.T.M. procedure, but using a 250 ml. flask, should be used.

(3) The vaporiser temperature must be determined experimentally by obtaining flash vaporisation data under vacuum. The yield data obtained under these conditions cannot be compared with plant figures owing to the poor separation obtained in this type of distillation. Flash vaporisation data for these heavy stocks cannot be accurately estimated by the common correlation methods. A graph is reproduced showing the wide variation in flash vaporisation data between stocks which in other ways appear to be alike.

Curves are given of the viscosity Saybolt Furol at 122° F. of blends of 100 pen. cracked and Mid-Continent asphalt with gas-oil. If straight residues and cut-back oils are used, the asphalt content by evaporation at 490° F. will generally be the same as the percentage of asphalt originally blended; whereas, if cracked asphalt or cracked cut-back oils are used, the asphalt content may increase sharply. This may also be true if very high boiling cut-back oils are used. If the penetration, ductility and viscosity curves of the asphalts are satisfactory, the other common specifications, *e.g.*, sp. gr., m. pt., solubility, fixed carbon, water and sediment sulphur, etc., will usually be found satisfactory if the materials were manufactured from straight petroleum residues. Blown asphalts would need to be examined more completely. C. L. G.

443. Estimation of Carbon, Hydrogen, Sulphur, Nitrogen and Oxygen in Residues (e.g., Bitumen). Anon. *Asphalt u. Teer*, 1933, **33**, 237–238.—Carbon and hydrogen are determined in the usual way by combustion. Sulphur is obtained by the bomb method, mixing 1 gm. of the sample with 1 gm. of potassium chlorate and 0·2 gm. benzoic acid. As an alternative method, 1 gm. of the sample may be heated with 5 ml. concentrated nitric acid saturated with bromine. Anhydrous sodium carbonate is then added and, after evaporating and burning off any residual organic matter, the

residue is dissolved in water, acidified with hydrochloric acid and the sulphate precipitated in the usual way.

Nitrogen is estimated by a Kjeldahl process, while oxygen is obtained by difference. C. C.

444. Construction of Graphical Charts. A. B. Steen. *Refiner*, 1933, **12**, 93–95.—There are two forms of chart: (1) rectangular, (2) alignment. In a rectangular chart for the example given, temperature is plotted on a horizontal scale and the specific heat on a vertical scale, different curves representing oils of different gravity. The disadvantage of this form of chart is the difficulty of interpolating between the lines for intermediate oils.

The alignment chart avoids this objection as each variable is represented by a line. To read this form of chart a straight edge is laid between two known factors and the desired value is read off at the point of intersection of the third line.

The construction of an alignment chart depends upon the equation connecting the factors involved. The form $ax + by = cz$ where x, y and z are variables, a, b and c being constants, yields three parallel lines.

An equation of the forms $axy = cz$ may be expressed as

$$\log ax + \log y = \log cz,$$

so that, by plotting the logarithm of the quantities, a parallel form is attained. The equation $axy = cz$ and $xy = z$, which may be transformed to $y\log x = \log z$, can be plotted directly by making the x and y lines parallel and both intersecting the z line.

The construction of a parallel chart is illustrated using the equation

$$C = \frac{1}{\sqrt{d}}\,(0{\cdot}388 + 0{\cdot}00045t) \text{ where}$$

c = specific heat B.Th.U./lb./Deg. F.
d = specific gravity.
t = temp., Deg. F.

which may be written

$$\log c + \log \sqrt{d} = \log (0{\cdot}388 + 0{\cdot}00045t).$$

B. C. A.

445. Thermodynamic Functions of Hydrocarbons from Spectrographic Data. L. S. Kassell. *J.A.C.S.*, 1933, **55**, 1351.—Convenient methods are given for the calculation of free energies and entropies from spectrographic data for polyatomic molecules, and examples have been worked for methane, acetylene and ethylene. It is shown that the results of spectroscopic calculations can only be represented satisfactorily by simple equations by including in Δ F/T, terms in $1/T^2$ and $1/T^3$. W. H. T.

446. Patents on Analysis and Testing. G. Duffing. E.P. 389,012, 9.3.33.—A viscometer consisting essentially of a ball suspended by a rod from a balance arm. A device is provided for indicating exactly the beginning and ending of the movement of the ball in its descent through the oil.

Vigzol Oil Refining Co. E.P. 389,163, 16.3.33.—An apparatus for estimating the lubricating values of oils. Tests are made by means of the inertia of a rotating member mounted on a lubricated surface of another rotatable number. W. H. T.

See also Abstract No. 395.

Class 600. Refining and Refineries.

447. Newer Developments in Refining and Utilisation of Petroleum Products. R. K. Stratford. *J.S.C.I.*, 1933, **52**, 266–267.—The author reviews progress in distillation and cracking equipment and discusses four major lines of development now in progress.

Firstly, the hydration of carefully fractionated cracking coil gases to higher alcohols, more particularly propyl and butyl, is effected via the alkyl hydrogen sulphate which is subsequently hydrolysed. The liberated alcohol is distilled from the acid, and after rectification washed with an acid-treated white oil which removes sulphonated compounds and higher alcohols. Eventually a product of 99% purity results in the case of isopropyl alcohol. Yields vary from 60–80%. Secondly, the author considers hydrogenation in the petroleum industry, and, thirdly, briefly describes the use of bentonite in treating gasoline. Fourthly, the phenol extraction process for lubricating oils is described. In this process the oil is dried with air and heated to 100–105° F., and then contacted with substantially anhydrous phenol in a counter-current treater. The treated oil is now charged to a still and 8–12% of the phenol distilled off and returned to the phenol tank. The treated oil which is stripped of all but minute traces of phenol is now finished with an active clay treatment. This simple and economical process improves the oil in all characteristics—*e.g.*, colour and colour stability, resistance to sludge formation, good viscosity index, etc. The phenol in the extract is recovered by distillation. W. E. J. B.

448. Volume Losses When Handling Hot Crude Oil. W. Woelflin. *Petr. Eng.*, March, 1933, **4** (6), 33.—In a previous article (see *J.I.P.T.*, 1933, Abs. No. 270) the gravity losses incurred when handling hot crude oil were discussed. The volume losses corresponding to various gravity losses from a range of Californian crude oils have been determined and plotted graphically. The following approximate relationship is obtained :—

	Per cent. volume loss.	
Loss in ° A.P.I.	22° A.P.I. Crude.	24–29° A.P.I. Crude.
0·5	1·7	0·9
1·0	3·4	2·2
1·5	5·1	3·9
2·0	—	5·6

Similar tests on 21° A.P.I. Smackover crude oil showed a volume loss of 2·8% for 1° A.P.I. gravity loss. It is probable that this data would apply to a large class of crude oils of corresponding gravity. C. L. G.

449. Theory and Practice of Testing Stills. A. J. V. Underwood. *Inst. Chem. Eng.*, 14.12.32. Advance proof, 41 pp.—This paper is largely mathematical, and the author has reviewed most of the known methods for the calculation of the number of plates theoretically required in a fractionating column for the fractionation of binary mixtures. Methods reviewed include those of Sorel, Savarit, McCabe and Thiele, Hausbrand, Fouché, etc., and the author decides that, for binary mixtures, no serious error is introduced by assuming constant molal reflux when the temperature difference between the top and bottom of the column is not large. The effect of withdrawing side streams is considered in relation to the continuous fractionation of complex mixtures, whilst operation under varying reflux rates and the most effective disposition of the feed plate receive attention.

The author provides various nomograms for use in calculating column characteristics, and considers briefly the practical aspect of testing distillation plant. W. E. J. B.

450. Automatic Pressure-regulating Unit for Vacuum Distillation. E. H. Huntress and E. B. Hershberg. *Ind. Eng. Chem. Anal.*, 1933, **5** (2), 144–146. —The device utilises the method of intermittent pump operation. Pressure reduction is effected with a Cenco Hyvac, which is switched off by the action of a thermionic relay system at the desired pressure. The whole outfit comprises: (1) Manostat; (2) manometer; (3) absorption train and reservoir; (4) relay; (5) pump and carriage.

(1) *Manostat.*—A U manometer which can be fastened in an inclined position. A fixed tungsten electrode contacts with the mercury completing the relay circuit which controls the pump motor. Tilting the manostat serves to reduce or augment the force required to bring mercury to the level at which it will make contact with the fixed electrode. A calibrated dial is used for measuring the amount of tilt. The slight lag induced by cohesion of mercury and the tungsten electrode is not serious, but can be avoided by use of iron or nickel.

(2) *Manometer.*—Constructed to be suitable for measurement of pressures between 0 and 30 mm. Hg. Increased sensitivity is obtained by use of lubricant such as butyl benzyl pthalate saturated with diphenyl mercury. By means of brass rings parallax errors in readings are overcome.

(3) *Absorption Train and Reservoir.*—Consists of short soda lime tower for acid gases with a low temperature vapour trap for water and organic liquids. The latter is a glass bulb trap cooled by solid carbon dioxide in a thermos flask.

(4) *The Relay.*—This has been developed for the purpose of controlling by means of a minute thermionic current, the heavy starting load taken by the motor for the pump. The wiring and layout of the relay, which can work on A.C. or D.C., is given. R. E. D.

451. Cracking Installation Adapted to Processing Asphalt. Anon. *Refiner*, 1933, **12**, 83.—A description of the adaptation of a cracking plant to process bottoms from an asphaltic crude to road oil or asphalt. B. C. A.

452. Treating System with Facilities for Purging. Anon. *Refiner*, 1933, **12**, 41–42.—For the treatment of pressure distillate a refinery in Arkansas assembled a plant consisting of eight vertical drums, approximately 30 ft. in height each. The incoming distillate is soda washed in the first drum by injection with a swirling motion into caustic solution. The pressure distillate rises through the solution and is passed to the second drum for water wash. Acid treatment is effected in the next four drums, leaving the sixth tank after contact with water. It is then rerun and the gasoline is doctor treated in the seventh drum being contacted in the same manner as in the preliminary caustic wash. The eight tank serves for the final water wash.

If on changing over from one pressure distillate to another rendering blending undesirable facilities are provided for purging the system of its previous contents, by pumping water into it, thus displacing pressure distillate and gasoline from the system. B. C. A.

453. Report of Fuel Research Board for the Year ended 31.3.32. *Dept. Sci. Ind. Res.* (H.M. Stat. Office, 1933, pp. 96).—The work is now divided into five main programmes: (1) Physical and Chemical Survey of the Coal Resources; (2) Purification and Cleaning of Coal; (3) Carbonization of Coal; (4) Hydrogenation of Tar and Coal; (5) Utilization of Coal in a Pulverized Form.

Investigations on the constitution of coal have been commenced by examining the action of solvents on the coal in an endeavour to ascertain which fraction is responsible for the swelling and caking properties. In particular

pressure-benzene and pyridine extracts have been fractionated by the use of other solvents, and the swelling capacities and caking indices of the coals and of the solvent fractions determined. The accuracy of solvent analyses and of ordinary methods of analysis of coal and coke has also been examined. Results obtained on cleaning of fine coals by the Elsmore vacuum system of flotation, using paraffin or paraffin-fuel oil mixture, are given, and the effects of "weathering" on recovery efficiency have been investigated. Experimental work on the carbonization of coal at temperatures below 800° C. in a brick retort has been continued, but the cast iron retort previously used for a similar purpose has been found unsatisfactory. Yields obtained from Dalton Main coal at varying rates of throughput are shown and the properties of the products compared. The effect on retort operation and on the yield of products when using coal which had been wetted has also been examined, and it was found that the two disadvantages of using wet coals are (1) reduction in throughput on dry coal basis; (2) reduction in yield of tar. Alteration and modification to the various retorts in use are described.

In order to carry out further investigation on the treatment of tars produced by low temperature carbonization of coal, with special reference to the production of motor spirit and other oils, a hydrogenation plant is being installed. A high-pressure converter is being designed to deal with 200/300 gals. of tar per day, and distillation and refining plant are being provided. A brief description of the proposed layout is given. Small scale hydrogenation of low temperature tars have been continued in the 2-litre converter. It was found that powdered molybdenum catalysts were more reactive in the presence of water. The reactions at high temperatures and pressures in the presence of hydrogen of pure compounds which occur in the tar acids, and of aromatic hydrocarbons found in low temperature tars, have been studied. Results of useful application obtained from this work are: (1) Elucidation of the mechanism of reduction of tar acids, facilitating choice of conditions for best treatment; (2) information concerning production of low boiling hydrocarbons from aromatic compounds; (3) discovery of products which deteriorate and of those which increase the effectiveness of catalysts.

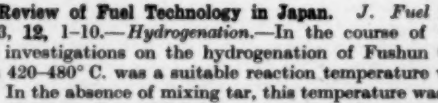
In the Bergius plant a low-temperature tar was treated at a temperature of 450/460° C. with hydrogen at a pressure of 200 atm. in the presence of molybdic acid catalyst in an endeavour to produce lubricating oil. From 1 ton of coal, 20 gals. of tar was obtained yielding 21·5 gals. of oil on hydrogenation. The oil was split up into 7·4 gals. of refined spirit (having an E.P. of 180° C., a high anti-knock value, but deficient in low boiling fractions), 12·4 gals. Diesel oil and 0·8 gals. refined viscous oil. This viscous oil was not sufficiently stable to air at moderately high temperatures to be classed as a good lubricating base. Work has been continued with the small continuous plant, and the modifications made are described and results given of typical experiments using charcoal containing 25% ammonium molybdate as catalyst for both liquid and vapour phase. Experiments show that a lower concentration of molybdate is efficient in the vapour phase, but deterioration is rapid. Experiments are in hand to find a means of overcoming this difficulty.

Satisfactory lubricating oil has not yet been produced by direct fractionation of neutral oils from low temperature tar. By the polymerisation of the unsaturated constituents of the light oils, using anhydrous aluminium chloride, a yield of approximately 30% of lubricating oil has been obtained. This oil gave satisfactory results during a 6-hr. test on an air-cooled J.A.P. petrol engine. The possibility of producing lubricating oils by partial hydrogenation of a low-temperature tar is also under examination, but so far without much success. Experiments have been continued on the hydrogenation of

coal and on the combustion of pulverized fuel. A suspension of coal in oil made with the aid of newly suggested stabilizer at the Fuel Research Station in 1930 shows little settlement after 2 years.

Other problems investigated include atmospheric pollution, briquetting pitch, domestic heating with coal and coke. A list of recent publications is appended. R. A. E.

454. Annual Review of Fuel Technology in Japan. *J. Fuel Soc., Japan*, January, 1933, **12**, 1–10.—*Hydrogenation.*—In the course of fundamental and practical investigations on the hydrogenation of Fushun Coal, Ogawa observed that 420–480° C. was a suitable reaction temperature when mixing tar was used. In the absence of mixing tar, this temperature was 425–450° C. Pressure up to 300 atm. favoured the reaction. Ando has conducted studies on the catalytic hydrogenation of phenol under high pressure using pure phenol, cyclohexanol and cyclohexene. In the presence of reduced Mo the reaction takes the following course with a reaction temperature up to 360° C. :—



A number of investigations on catalysts used for the production of hydrogen by means of oxidation of water gas with steam have been made. Yoshimura finds that loss in activity, volume contraction, and magnetic transformation of Fe_2O_3 occurred all nearly at the same temperature, *i.e.*, just below 700° C., *viz.*, 650–680° C. Addition of Cr_2O_3 lowered the magnetic transformation point linearly but was without effect on point of volume contraction. From these results he concluded that the loss of activity and contraction of volume of Fe_2O_3 was due to a change of crystal angle to a more stable configuration. Ikeda and Ogura found a catalyst consisting of Mo Al_2O_3 (or MgO) to be most effective for the oxidation of natural gas by means of steam. S. B.

455. Hydrogenation of American Coals in Anthracene. W. L. Beuschlein and C. C. Wright. *Ind. Eng. Chem.*, 1933, **25**, 409.—Experimental data are presented for the hydrogenation of a series of American coals with anthracene as the dispersion medium. A mixture of finely divided coal and anthracene in the ratio of 2 to 1 was hydrogenated under constant volume conditions at 350° C. for a period of 8 hrs. The initial hydrogen pressure at room temperature was 141 kg. per sq. cm. The products were extracted with benzene in a Soxhlet apparatus, and the insoluble residue was then carbonized at 550° C in a Fischer retort. In a second series of experiments nitrogen was substituted for hydrogen. It was found that the yields of gas and liquor resulting from the low temperature carbonization of the extracted residues from the nitrogen experiments were approximately twice as great as those from the corresponding experiments in which hydrogen was used. The conclusion drawn was that hydrogenation involved the conversion into benzene-soluble products of those constituents of the coal which normally produce the gas and liquor fractions upon low-temperature carbonization. The coals showing the most satisfactory conversions, as indicated by the difference between the percentage of coke produced in the nitrogen and in the hydrogen experiments, belonged to the low-ranking bituminous and sub-bituminous classes. No satisfactory correlation was possible between the degree of conversion and the classification of the coal. There was a definite lack of correlation between conversions determined by methods similar to those used in commercial practice and those based upon the conversion into phenol-insoluble residues. E. N. H.

456. Study of Bleaching Clays. P. G. Nutting. *Refiner*, 1933, **12**, 80–82.—This article summarises results obtained since the publication of the report in *Ind. Eng. Chem.*, Jan. 15, 1933. The bulk of the production of naturally active clays is from a group of deposits on the Georgia-Florida border. These clays are low in bleaching power (0·7—0·9), but may be granulated for percolation and re-burned for re-use. Japanese active clays and English "Fuller's Earth" rate at about 1·3 and 1·2 respectively. Japanese and Floride clays are not improved by acid leaching, but the bleaching power of the latter clay may be raised to 1·2 by dialysis and to 1·8 by cation treatment. Clays of the inactive, but activable type, are largely bentonites, originally volcanic ash, decomposed and partly leached. Pure bentonites activate up to a value of 2·0 and impure varieties to 1·3 to 1·7.

Ferromagnesian igneous rocks after acid leaching frequently show bleaching power equal to that of the best clays, but are usually too local in occurrence to be of commercial interest. A third source of bleaching material is glauconite or greensand. Deposits occurring along the Eastern Coastal Plain are described in *U.S. Geol. Surv. Bull.* 660B and 727. For the contact process in refining mineral oil glauconite must be ground and acid leached. The product is not, however, a good bleach for mineral oils (1·0). Control of leaching through control of time, temperature, of concentration of acid is not possible as some grains leach far more readily than others. The leaching has been limited and equalised in the author's experiments by the expedient of adding salts to the leaching acids (the chlorides of Fe, Al, Mg., etc., to HCl, or the sulphates to sulphuric acid) when the leaching progresses to a maximum activity equal to that of the best treated clays, and then stops. The same process is applicable to those bentonites which yield too readily to acids.

Thirty clays have been tested, representing the limits of variation in American clays. The maximum bleaching power observed was 2·0. Values are tabulated for the bleaching power of the raw and acid treated forms, the acid soluble percentage and the proportion of metals removed. The loss in weight on heating from 25–160° C. and from 160–800° C. is also given.

Some clays appear to leave the bleached oil more stable in colour than others. For each clay there appears to be an optimum temperature of bleaching activity. Some clays crack even pure saturated paraffins, such as laxative oil or fused paraffin wax, while others do not. The bleaching power of clays is affected by drying conditions and sometimes by ignition. In some cases bleaching ceases abruptly, whilst others yield a series of green, yellow, orange and red oils. B. C. A.

457. Copper as Refining Agent for Petroleum Distillates. G. H. von Fuchs. *Petr. Zeit.*, 1933, **29** (11), 5–8.—A method is described for refining light distillates of high sulphur content ("straight-run" or cracked) by means of copper, the mercaptans present in the distillates being converted into copper mercaptides. The copper is used in the form of the oxide or as precipitated metallic copper, and the reaction is accelerated by adding traces of alkalies and acids, *e.g.*, ammonia, hydrochloric acid and gaseous sulphur dioxide. The mercaptides formed are removed by treating with sulphuric acid (fuming acid for straight-run distillate) and ferric chloride of 58% concentration. Cracked distillates are sweetened by suspending copper oxide or precipitated copper in the oil before the acid treatment. The ferric chloride solution used for converting the copper mercaptide into the disulphide is regenerated by oxidation with air. W. S. E. C.

458. Absorption Plant Designed for Unusual Weather Conditions. Anon. *Refiner*, 1933, **12**, 76–79.—A conventional design of lean gas plant, but operating in an area where prevailing winds are 10–80 m.p.h. and the winter

minimum temperature 50° F. below zero. Practically the whole of the absorption and distillation equipment is housed in a lined steel frame building, heated by six 2-in. steam pipes disposed round the bottoms of the walls in the interior. All cooling is done in atmospheric type cooling sections, mounted in a cooling tower, consisting essentially of a box provided with water sprays at the top and open along both sides at the bottom. Solid fences are spaced out from the tower at the bottom to break the direct passage of wind, and the amount of air passing is regulated by hinged hatches extending from the tower walls to the fences. The finished gasoline storage tanks are heated by a 3-in. pipe running lengthwise internally, inside which runs a half-inch pipe for steam. This arrangement eliminates trouble from the freezing of precipitated water. All yard piping for continuous flow is buried 4 ft. and for intermittent or slow flow 6 ft. When lines come to the surface they are packed in wood chips in wooden boxes. B. C. A.

459. Influence of Temperature on Reforming Naphthas. J. C. Albright. *Refiner*, 1933, **12**, 2–4.—A mixer charge of cold heavy naphtha, 300° F. Initial and 475/500 Final Boiling Point from a crude distillation unit and hot heavy naphtha taken as side stream from cracking plant bubble tower is passed through a bank of tubes placed in the upper section of the wall bank of a combination cracking and reforming furnace. A furnace temperature of 1300° F. raises the temperature of the charge to 1010° F. at the outlet of the reforming bank at a pressure of 370 lb. The heated oil is discharged to the evaporator, common to the cracking and reforming cycles, where pressure is reduced to 50 lb. The vapours pass overhead through heat exchanger for gas oil charge to cracking still tubes and thence to bubble tower. The combined pressure distillate after debutanisation and refining and re-running has Gravity A.P.I. 56, Colour 30, Reid Vapour Pressure 7·0 lb., Octane No. 70, I.B.P. 102, F.B.P. 394.

Charts for the Octane Number of the naphtha 400 E.P. plotted against varying reforming coil temperatures, with pressure remaining constant and against varying pressures with temperatures constant are given, the naphtha charge to the reforming coil being held constant in each case. In the temperature range tried, the maximum temperature of 1010° F. gave a gasoline of 71 Octane No., whilst the minimum temperature of 998° F. yielded a 69 Octane Number gasoline. A similar phenomenon was noted in varying the reforming coil inlet and outlet pressures, whilst holding charge outlet temperature constant at 1010° F. B. C. A.

460. Production of Lubricating Oils by Extraction with Dichloroethyl Ether. J. M. Page, C. C. Buchler and S. H. Diggs. *Ind. Eng. Chem.*, 1933, **25**, 418; *Nat. Petr. News*, 5.4.33, **25** (14), 35.—This paper deals with the production of high-grade lubricating oils by the extraction of petroleum fractions with $\beta\ \beta'$-dichloroethyl ether, a highly selective solvent now available in commercial quantities under the trade name of Chlorex. The high specific gravity of this solvent (1·222 at 20°/20° C.) permits easy separation of the two phases formed with oils. Its boiling point (178° C.) is well below the vaporisation temperature of all grades of lubricating oils and the low vapour pressure (10 mm. at 100° F.) precludes the possibility of large storage losses. Extraction is usually carried out in the range −1° to 27° C., and here the low viscosity of the solvent is an important advantage. At ordinary temperatures this solvent is non-inflammable and under normal operating conditions it may be regarded as non-poisonous.

The solvent action of dichloroethyl ether is compared with that of nitrobenzene and of acetone; the conclusion is made that dichloroethyl ether approaches the ideal selective solvent. Data are given on the extraction of

various oils. Lubricating oils equal to Pennsylvania grade in viscosity index and surpassing them in both resistance to oxidation or sludging, and in those properties controlling carbon formation in the engine have been prepared by dichloroethyl ether extraction of distillates from Salt Creek and Midcontinent crude oils. A small saving of solvent and an improved colour may be obtained by combining solvent extraction with acid treatment.

Methods of extraction are compared to the advantage of countercurrent operation. A commercial plant, based upon a three-stage countercurrent system of extraction, has been operating for nearly a year at the Casper, Wyoming, plant of the Standard Oil Company (Indiana). The capacity of this plant was 500 bbl. of finished oil per day. The presence of wax is no hindrance to extraction, and the plant has operated with a wax-bearing stock of pour-point 48·9° C. For solvent recovery steam distillation has been used. No trace of solvent is left in the oils. The reaction of solvent with either raffinate or extract during distillation has been negligible. Hydrochloric acid is formed only in minute quantities during distillation with steam and should be neutralised. Having once removed all traces of hydrochloric acid, recovered solvent is found to be much more stable than the new product. The loss of solvent in operation does not exceed 0·2% per cycle.

E. N. H.

461. Preparation of Butyl Alcohol from Cracking Still Gases. Anon. *Refiner*, 1933, **12**, 27–32.—Butylene concentrate at –10° C. containing 35–40% each of isobutylenes and normal butylenes, and 18–20% of divinyl, was added to sulphuric acid at the same temperature, and the mixture agitated by hand for varying periods and temperatures. After settling for 30 mins. the liquid was cooled to –10° C. and the acid layer siphoned off. The acid solution with the addition of ice was stood for 12 hrs. and separated polymers removed from the surface. The aqueous solution was made slightly alkaline and fractions boiling below 100° C. removed by distillation. The alcohol was salted out by potash from the distillate. Subsequent fractionation yielded a fraction boiling up to 85° C. and a second boiling at 85–100° C. The first fraction corresponds approximately to trimethylcarbinol and the second to ethyl methyl carbinol.

In addition to the polymers separating from the surface of the aqueous solution, others dissolved in unchanged butylene concentrate and were separated from the latter by distillation on the water bath, up to a bath temperature of 50° C., the receiver maintained at –10 to –20° C. serving also as condenser. Addition of the two quantities gave the total amount of polymers.

The increase in weight of the acid after reaction showed the amount of butylene concentrate participating in the reaction, and by subtracting the amount of polymers separating on the addition of water (ice) the amount of hydrocarbons converted to alcohol is obtained. Finally the yield of alcohol was measured.

The following factors were investigated :—

1. Acid strength, from 45–85%. The highest alcohol yield of 4 to 8% without a simultaneous formation of polymers was attained with 50–55% acid. Polymers increased progressively to 40% up to an acid strength of 70%. Less polymers and more alcohols, but of the higher boiling range, were produced using 75% acid.
2. Duration of treatment at 5 and 12 hours. A shortening of the treating period leads to lower yields of alcohols and polymers.
3. Variation in agitation. At low acid concentration, the alcohol yield increased considerably without a corresponding increase in polymer

formation. At 65% acid and over alcohol and polymer yield were simultaneously affected.

4. Temperature. By decreasing the treating temperature from +8° C. to −10° C. using 60% acid polymer formation was eliminated. Similarly at 0° C., 65% acid gave a diminished yield of 8% of polymers as compared with 28% previously. By giving down to −20° C. polymer formation was further reduced but complete elimination did not appear possible.

Butylene concentrate was treated with 60% acid for 5 hours at −10° C. with vigorous agitation, and the concentrate remaining after the reaction was further treated with 65% acid for 20 hrs. at a temperature rising to a maximum of 30° C. A total yield of 33% of alcohol was obtained, 23% from the neutralised acid sludge and 10% recovered from the polymers by distillation. Butylene concentrate remaining after the second treatment was treated with 70% acid for 10 hours at −30° C. yielding 12% of alcohols. B. C. A.

462. Preparation of Ethyl Alcohol from Ethylene (Part II.). V. Gerr, O. Pipik and E. Mezhebovskaya. *Refiner*, 1933, **12**, 96–99.—As the result of laboratory and experimental plant investigation it is concluded that: (1) Ethylene is separated from homologues by charcoal and concentrated up to 85%; (2) ethylene is absorbed by sulphuric acid forming ethyl sulphuric acid and the alcohol may be separated by hydrolysis; (3) silver and iron in the acid catalyse the absorption of the ethylene, the former being more effective; (4) technical or pure alcohol may be produced depending upon the ratio between the gas and charcoal; (5) the constants of the synthetic alcohol coincide with those of fermentation alcohol; (6) the charcoal may be regenerated by treatment with steam superheated to 250–300° C. B. C. A.

463. Candles and Candlemaking. D. Allan. *J. Inst. Petr. Techn.*, 1933 **19**, 155–175.—A lecture, with discussion, on the manufacture of candles from the earliest times to the present day. G. R. N.

464. Cost Accounting and the Chemical Engineer (Part II.). A. G. Peterkin and H. W. Jones. *Refiner*, 1933, **12**, 100–103; *Chem. Met. Eng.*, 1933, **40**, 133–135.—The principles and mechanism involved in these systems are applied to the operating and sales statistics of an imaginary petroleum refinery for January in an argument, supported by eight tables comprising Standard Costs, varying with Throughput Rate; Actual Plant Costs for January; Standard Costs varying Rate independent of Throughput Rate; Comparison of Standard with Actual Manufacturing Cost for January; Standard Realisation and Profit on Standard Products in a Standard Month of 30·5 days; Actual Realisation on Actual Products in January; Variation of Actual Sales Realisations from Standard; Analysis of Profit after Deducting Selling and Administrative Expenses. The responsibility for a failure to realise the anticipated profit for the month is analysed, and the quantitative responsibility therefor is assigned between the Manufacturing Manager, Purchasing Agent and Sales Manager. A list of nineteen references is given for further reading in connection with cost accounting. B. C. A.

465. Standard Costs in the Oil Refining Industry (Part II.). G. C. Harrison. *Refiner*, 1933, **12**, 104–107.—The work of introducing standard costs into an oil refinery may be divided into: (1) Setting of the standards; (2) design of the system; (3) installation of the system; (4) operation of the system; and to secure full value from such a system it is essential that it should be introduced as a co-ordinated whole and not piecemeal.

The standard cost schedules should be approved by the operating staff of the departments concerned, and the first step in their setting is the preparation of charts showing all costs in relation to productions. With cost as ordinate and production as abscissæ a standard cost line is drawn which will intersect the ordinate at zero production, thus giving the fixed charges. When the costs of a given operation are comprised solely of fixed charges and, variable costs fluctuating directly with production, the standard cost line will be straight. If the fixed charges are reduced when production is curtailed, the standard line will be represented by a series of straight lines in steps.

The factors involved in the determination of the economic limit for clay recovery, as a problem which standard costs will solve, are discussed. It is pointed out that whereas clay recovery reduces the cost of clay per gallon of oil due to increased clay burning, numerous factors have to be offset against this saving. These are due to increases in clay loading and dumping, filter and filter washing hours, oil loss and depreciation, naphtha in wash and loss, steam in washing and in steam stills. B. C. A.

466. Arc Welding in the Erection of Six Steel Towers. F. O. Blair. *Refiner*, 1933, **12**, 16–18.—The application of arc welding to the erection of 6 steel towers (8 ft. by 40 ft.) resulted in the reduction of erection costs from an estimated amount of $120.00 cost per tower using structural steel brackets to an actual cost of $32.00 per tower incurred by the use of arc welding.

The towers were set singly in place on blocks and held by temporary guys over a concrete foundation 5 ft. deep in which was embedded for each tower 10 by 1 in. rods of reinforcing steel equally spaced around the circumference and projecting 5 ft. above the foundation. The upper foot of the reinforcing rods were welded to the sides of the towers. Forms were then placed and concrete walls 18 in. thick were poured, so that a 6 in. covering of concrete over the welded portion of the reinforcing rods and a 12 in. base for the towers was produced.

For the 6 towers the estimated saving over expenditure for structural steel brackets was $528.00. It is suggested that the idea may be applied to the erection and support of similar types of steel structures such as towers, standpipes, tanks, smoke stacks, steel columns, etc. The base walls may be split for pipe connections. B. C. A.

467. Heads for Tanks and Heat Exchangers. C. O. Sandstrom. *Chem. Met. Eng.*, 1933, **40**, 138–141.—This third and final article deals with the construction of removable heads for heat exchangers, cone bottoms and flat covers. Calculations of the stresses set up in these heads when bolted on are given and from these a new type of removable head has been designed. Several diagrams of heads are given which indicate the direction and amount of stress set up. G. R. N.

468. Improving Automatic Control. W. R. Clendinning. *Chem. Met. Eng.*, 1933, **40**, 123–125.—The author discusses the various types of automatic control and their correct application. Controllers are grouped as fast-action and slow-action types. These two main groups are subdivided according to the medium that exerts the control, *e.g.*, air, mercury, electricity, etc., which is further characterised by speed of response to change. The time lag of controllers is also discussed and the means for either using or neutralising its effect are indicated. The value of detailed interpretation of controller charts is clearly shown. G. R. N.

469. Rotary Pumps for Handling Acid Sludge. H. A. Rogers. *Petr. Eng.*, March, 1933, **4** (6), 32.—After considerable experimental work a rotary pump to handle acid sludge has been perfected to operate 24 hours a day with no more attention than pumps in any other service. Particular attention was directed to the anti-corrosive metal alloy used and to the design of stuffing box and type of packing to avoid leakage. Owing to the amount of circulation required a rotary pump of sufficient capacity is recommended. For small quantities of sludge a small rotary pump running at 860 r.p.m. and directly connected to a motor should be used, while for larger quantities of sludge the speed should be reduced, using either a slow speed motor, a reduction gear built into the pump or a steam turbine with a built-in reduction gear. The pumps should be able to operate at a considerably higher pressure than normal owing to the viscosity of the sludge when cold. Positive displacement is necessary owing to the abrasive nature of the sludge, while the pressure should be held constant to avoid pulsations at the burner tip.

The installation of the pump should be carefully made to avoid pipe strains and a stand-by unit should be available in case of necessity. C. L. G.

470. Refining Capacity Dominated by Few Concerns. G. Reid. *Refiner*, 1933, **12**, 19–26.—Operating refineries in U.S.A. number 370, with a capacity of 3,625,000 brls. per day. In addition there are 110 refineries shut down, yielding an aggregate capacity of 4,025,000 brls. per day. 80·7% of the total rated refining capacity and 89·61% of the total operating capacity is controlled by 22 integrated companies, operating 177 refining plants. These companies own 90·86% of the total operating cracking capacity of 1,650,000 brls., despite the abandonment of old cracking processes. Fifteen out of this selected group of 22 companies are stockholders in Hydro Patents Company, which controls all hydrogenation patents in U.S.A., and this smaller group own 69% of the total operating crude refining capacity and over 80% of the operating cracking capacity in the country. That is, two-thirds of the refining capacity of the United States is owned by concerns now financially interested in the hydrogenation process.

The majority of the shut down refinery capacity of the industry is found among the smaller concerns, as with a total inoperative capacity of about 400,000 brls. per day only 25,000 brls. is owned by the group of 22 companies under discussion. In the field of cracking the smaller concerns have 68 shut down out of a total of 108 units.

A statistical analysis of facilities owned by the 22 companies is presented, with particular reference to the cracking capacity, number and type of cracking units employed. In the preliminary analysis the integrated companies are arranged in order of crude charging capacity. Seven companies have a crude charging capacity of 200,000 brls. per day and upwards, five between 100,000 and 200,000 brls. per day, and the remainder less than 100,000 brls. per day. In a further analysis the parent and subsidiary companies constituting the 22 integrated companies are shown together with refineries, rated crude and cracking capacity, and number and type of cracking units attaching to each. B. C. A.

471. Refinery Combustion Calculations. W. L. Nelson. *Petr. Eng.*, February, 1933, **4** (5), 44.—Attention is drawn to the misleading results of refinery combustion calculations given by using the Gross Heat of Combustion instead of the Net Heat, since it is generally impossible to condense the water vapour, the loss of heat in which is charged against the still if the gross heating value is taken.

Tables are given showing the combustion properties of common refinery fuels, and it is shown that the % of CO_2 in the flue gas and the air required

for combustion do not vary greatly. The most serious loss occurring in a furnace is the heat contained in the stack gases, as it is impossible to cool these to 60° F., which is the temperature which is used as the basis for the heat of combustion figure. The sensible heat loss due to the heat contained in the stack gases may be computed, but for practical purposes the stack loss charts reproduced are entirely satisfactory.

The factors affecting atomisation of the oil are :—(1) design of burner ; (2) use of atomising steam ; (3) viscosity of oil fuel, the amount of steam required depending on the viscosity of the fuel at the firing temperature. Generally fuel oils are heated to such a temperature that their viscosity is under 30 centipoises (approximately 150 secs. Saybolt Universal). With a fuel at these temperatures the following quantities of steam are required for varying quantities of fuel :—

Lbs. oil per burner per hour ..	400	600	800	1,200
Lbs. steam per lb. fuel	0·415	0·267	0·20	0·132

As several burners are desirable the usual quantity of fuel fired through each burner in pipe still service is about 500 lbs. per hr.

The necessity of maintaining a flow of oil in all parts of the fuel circulating system when using heavy fuels is stressed, and reference made to the advantage of maintaining a separate circulating system for each pipe still unit to facilitate the adjustment of minor fluctuations in the rate of firing by controlling the pressure of the circulating system without adjusting the burner itself. C. L. G.

472. Utility of Graphical Charts in Design and Operation (Part II.). C. M Johnson. *Refiner*, 1933, **12**, 88–93.—The application of calculating charts to refinery operations is discussed, taking as an example charts dealing with the operation of Holmes-Manley Cracking units. Chart No. 1 shows pump capacity in brls. per hour against strokes per minute with varying pump efficiency. This chart did not take into account varying diameters of plungers and Chart No. 2 was substituted, showing brls. per hour and gallons per minute plotted against plunger strokes and varying diameter plungers. Later a tendency to short strokes was allowed for by the construction of Chart No. 3, giving brls. per stroke for varying diameter plungers at varying lengths of stroke. A fourth chart was constructed to reduce all volumes to 60° F. and to ascertain the flow velocity in the heating tubes either at hot or cold volume. A further addition was Chart No. 5, which shows the pressure drop per 1000 ft. of pipe after first finding the flow velocity. On chart 6 is plotted production against charge rate to read the per cent. yield, whilst Chart 7 gives the interconnection for three batteries operating at 80% time on stream, of charge in brls. per hour and month, and naphtha production at varying percentage yields, per unit and per triple unit. B. C. A.

473. Patents on Hydrogenation. I. G. Farbenind A.-G. E.P. 389171, 16.3.33.—Conversion of naphthalene into hydrocarbons of the benzene series by treatment with hydrogen at 50–350 atm. and 340°–440° C. in the presence of a catalyst consisting of an oxide of molybdenum or tungsten. The resultant product is again hydrogenated at 460°–500° C. in the presence of a catalyst consisting of the same oxides. W. H. T.

474. Patents on Gas. I. G. Farbenind A.-G. E.P. 389,165, 16.3.33.—A method of obviating the deposition of carbon during the conversion of hydrocarbon gases in an electric arc. The striking points of the electric arc are caused to move rapidly on the surfaces of both electrodes at a velocity of more than 20 cms. per second. W. H. T.

475. Patents on Motor Fuel. Silica Gel Corporation. E.P. 388,782, 28.2.33. —Refining liquid fuels containing gum-forming constituents. The material is treated with sulphuric acid (4% of 62°–44° Bé), water is then added and the acid separated from the mixture. The treated material is next neutralised, distilled, and the distillate washed with water containing 0·1% of alkali.

Dupont de Nemours. E.P. 388,826, 9.3.33.—Liquid fuels are stabilised with regard to gum formation or development of colour by the addition of 0·001–0·01% by weight of a secondary arylamine Ar. N.H.R., Ar. being a hydrocarbon of the benzene series and R being an aromatic, aliphatic or aromatic-aliphatic hydrocarbon radical other than a naphthyl group. The use of aromatic amines in conjunction with iron carbonyl or with ketones or alkyl ethers is excluded. W. H. T.

476. Patents on Lubricating Oil. S. E. Bowrey. E.P. 388,969, 9.3.33. —A method of preventing deterioration of insulating oils in which the oil is dried and deaerated by the action of inert gas under pressure in a closed vessel, being afterwards returned to the main oil container.

I. G. Farbenind A.-G. E.P. 389,113, 6.3.33.—Removal of asphaltic or resinous material from heavy oils by treatment with liquefied gaseous hydrocarbons under pressure and slightly elevated temperature. W. H. T.

477. Patents on Asphalts and Fluxes. J. Radcliffe. E.P. 388,731,27. 2.33.— Manufacture of a road-making composition. Sand is mixed with an excess of binder while hot, and the mixture added to a further quantity of cold sand, so that films of binder are formed between over-coated and uncoated particles. W. H. T.

478. Patents on Fuel Oil. A. Haeck. E.P. 389,203, 16.3.33.—Manufacture of mixtures suitable for carburation or combustion from oils wholly or partly unfit for such uses. The oils are slowly heated to a moderate temperature under reduced pressure, and the vapours evolved passed upward through a column fitted with trays maintained at such a temperature that no condensate returns to the still. The vapours are thus homogenised and are ultimately condensed. W. H. T.

479. Patents on Special Products. A. Schaarschmidt. E.P. 388,734, 28.2.33.—Production of ketones (and aldehydes) from aliphatic or alicyclic hydrocarbons by treatment at low temperatures and elevated pressure with carbon monoxide or phosgene in the presence of metallic bromides or iodides with or without the addition of cuprous halides or a halogen hydride.

H. Dreyfus. E.P. 389,133, 13.3.33.—Manufacture of aliphatic alcohols from olefines by direct hydration with steam at elevated pressures and in the presence of an aqueous strong acid in the liquid phase.

H. Dreyfus. E.P. 389,136, 13.3.33.—Conversion of olefines into alcohols by hydration of the former in the presence of basic substances by means of water vapour. The reaction takes place at 100°–300° C. and at pressures between 10 and 50 atm. W. H. T.

480. Patents on Refinery Plant. Gustav. Ruth A.-G. E.P. 389,411, 16.3.33. —A protective coating for tanks, etc., resistant to liquid fuels. An anti-corrosive paint is used for a priming coat upon which is applied a second coat of a paint prepared from a binding medium of a casein or casein oil emulsion. The second coat is rendered impermeable by the application of a third coat consisting of a pigmented solution of resins insoluble in benzene or benzol. W. H. T.

Class 700. Utilisation.

481. Petroleum Coke as a Furnace Fuel. G. Vandenburg. *Refiner*, 1933, 12, 11–15.—Petroleum coke, because of its low ash content, is hard on grate bars, but by reduction to fine powder it may be burnt with or alternative to oil and gas. Coke dust is burnt under forced draught, the added air serving both for whirling and combustion.

A high combustion rate in B.Th.U. per cu. ft. per hr. of combustion space reduces capital investment. This rate may be increased by: (1) diminishing excess air; (2) decreasing the combustion time of the particles. The smaller the size of the particles, the shorter is the combustion time, which is also diminished by temperature and turbulence.

With decreasing size of dust particles, the rate of combustion increases progressively until a certain fineness is reached at 10 microns ($10 \times 1/1000$ of 1 mm.), when the rate increases infinitely and the velocity of combustion takes the property of explosion. As a practical issue it has been determined that, by grinding to a common fineness so that 10 to 20% remains on a 30,000 mesh screen, the major proportion is suitable for the highest combustion rates and only a minor proportion of the largest sizes does not burn completely.

With falling temperature, the capacity of the combustion chamber rises, because of fall in gas volume, but, contrary to this effect, the combustion velocity decreases. The two influences do not counterbalance because in dealing with gas volumes the mean temperature of the gases in the combustion chamber is determined, whilst for the velocity of reaction the temperature of the reacting layers is significant, these quantities being different. The increase in capacity through lower temperatures progresses with diminution of combustion time, and becomes important when using fine material.

There is, therefore, for pulverised fuel furnaces a definite temperature, corresponding to a maximum combustion rate, when the favourable influence of lower gas volumes can still be attained, and it is undesirable to attempt to increase furnace capacity by the use of the highest possible temperatures, which involve difficulties in the maintenance of furnace walls and fusion of the ash. The mean combustion temperature should be kept below the melting point of the ash of the coke used.

Because of the influence of the temperature and concentration of oxygen upon the velocity of reaction, the temperature at the reaction surface being lower during the processes of decomposition of the fuel and higher during combustion than the mean combustion temperature, and the diminution of oxygen concentration at the reaction surface, it is necessary to induce turbulence by all known means in order to disturb layers around the dust particles. B. C. A.

482. Oil Burners. C. Finaton. *Rev. Petr.*, 25.3.33 (520), 287–289; 1.4.33 (521), 311–314.—Oil burners are classified as: (1) vaporising; (2) atomising by distillation; (3) atomising by pressure of oil; (4) atomising by centrifugal dispersion. The "Amifeu" and "Adday Haag B.P." are representative of class (1). In the "Amifeu" the fuel oil is dropped on to a plate heated to a temperature sufficiently high to bring about complete vaporisation. The vapours mixed with a controlled volume of air are burned and the heat generated is used to heat water contained in a jacket that forms the walls of the combustion chamber. In the Adday Haag burner the oil enters tangentially a tray of refractory material and impinges on a hollow cylindrical cast-iron mushroom. The latter is heated by the passage of hot air through it to a temperature high enough to vaporise the bulk of the oil. The top of

the mushroom is perforated. The hot air and vapours commingle in the space above the mushroom and are ignited. The burner is so designed that there is sufficient air to promote combustion of the unvaporised oil in the refractory tray as well as the vaporised portion. Classes (2) and (3) cover the more important types of burners, the main features of which are the atomisation by air of the oil in a suitable chamber. The oil-feed pipe and nozzle are centrally placed in the air duct. Several burners of this class are described, which include the Prométhée Oléocalor, Babcock and Wilcox, Peabody and Quiet May. In burners of class (4) the oil is converted to a fine mist by centrifugal force before mixing with air; burners of this kind are the Wayne and Petro. G. R. N.

483. Some Notes and Observations on Petrol and Diesel Engines. H. R. Ricardo. *J. Inst. Aut. Eng.*, March, 1933, 13–30.—Two problems are dealt with in this paper, *viz.*: the cracking of white metal linings of the big end connection rod bearings of high-speed Diesel engines, and secondly, the problem of cylinder wear. With regard to the first, the author compares the conditions as between a petrol and Diesel engine. Typical indicator diagrams of a petrol and a Diesel engine are given, showing that while the maximum pressures in the petrol engine, from idling to full load, range from approximately 50 to 450 lb./sq. in., those of the Diesel for similar loads are from approximately 600 to 700 lb./sq. in., so that shorter life is to be expected. The main difficulty of the problem lies, however, in the fact that the experiences of manufacturers are so contradictory. Details are given of many types of engines with typical full-load diagrams of each type. An analysis of the experiences of manufacturers of these various types at home and abroad shows the results obtained to be hopelessly conflicting. The author considers that there are, however, certain general conclusions which can be drawn, *viz.*: (1) That where the cost permits of the use of hardened crankshafts the use of harder big end linings can be employed, which give no trouble. The risk here, however, is from seizure, as foreign matter cannot bed itself into the lining as is the case with white metal. Floating bearings are also claimed entirely to obviate the trouble. (2) Where white metal is employed, it is best to use very thin linings of the order of 10 to 20 thousandths of an inch. Several theories which have been put forward in connection with the problem are quoted, but none are considered a satisfactory explanation of the conflicting evidence. With regard to the problem of cylinder wear, the author has collected information over a period of years dealing with all kinds of I.C. engines, and has arrived at the conclusion that speed has no bearing on the subject, and that the nature of the wear is the same in all cases, *viz.*: a deep groove corresponding to the topmost position of the top ring, tapering fairly rapidly at first, then more rapidly to a minimum at mid stroke, after which it remains nearly constant to the end of ring travel, where it increases again very slightly. The supposed reason for wear, *viz.* abrasion, is dealt with, and it is proved to the author's satisfaction that abrasion cannot be even a major factor in the problem.

The author's conception of what occurs is as follows: As the top ring nears top centre the oil film begins to break down, and the pressure behind the ring increases, and at top centre the liner is squeegeed till it is practically dry. As the piston descends the liner at the top is exposed to the products of partial combustion, which attack the unprotected metal, and thus cause the damage.

The author quotes many stray observations which he claims corroborate his theory. C. H. S.

484. Vapour-Handling Capacity of Automobile Fuel Systems. O. C. Bridgeman, H. S. White and F. B. Gary. *J.S.A.E.*, 1933, **32**, 157–163.—Vapour-lock in cars is influenced by the capacity of the fuel system to handle excess vapour, as well as by the fuel line temperatures and the nature of the fuel. It has been shown the gravity-feed and vacuum-tank systems have little capacity for handling excess vapour, while fuel-pumps can deal with comparatively large excesses of vapour.

In the present report 46 cars (dating from 1926 to 1932) and equipped with gravity-feed, vacuum tank and fuel-pump systems, were examined under three sets of operating conditions, viz. : (1) Steady driving at about 40 m.p.h. ; (2) idling after steady driving ; (3) accelerating after idling. The fuels used were blends of butane with a low vapour-pressure refinery gasoline. The butane contents ranged from 7 to 35%, and the vapour-pressures from 12 to 27 lb./sq. in. (Reid).

The general relation for prediction of vapour-lock is based on the value V/L=1, for the ratio of the volumes of vapour to liquid at the vapour-locking-point. In general, the vapour-handling capacity of the fuel-system is expressed by the value of this ratio V/L, at the vapour-locking point. For V/L=1, it has been shown that : $t=259-140 \log. p_R$, where t is the vapour-locking temperature and p_R is the Reid vapour-pressure of the fuel. Curves are given showing the relation between the temperatures predicted on this basis and the observed vapour-locking temperatures for the 46 cars under each of the three conditions noted above. There is in most cases, especially with the cars fitted with fuel-pumps, a considerable margin of safety.

The temperature at which the vapour-pressure equals atmospheric (*i.e.*, the vapour-locking temperature) increases as the ratio V/L increases. It is, then, possible to determine the ratio of V/L for a fuel-system by determining the temperature of vapour-lock and comparing this with the curve relating temperature and V/L ratios for various gasolines. A series of these curves for fuels of different vapour pressures were obtained by using an apparatus of the Reid type, but employing various ratios of V to L.

For constant-speed operation the following results were obtained for the 46 cars : V/L, 0–10, 11 cars ; V/L, 11–20, 13 cars ; V/L, 21–30, 12 cars ; V/L, 31–40, 6 cars ; V/L, 41–50, 4 cars.

It has previously been shown that the average rise of temperature in the fuel line above atmospheric, for a fuel of low vapour-pressure is about 31° F. Under vapour-locking conditions the rise is only about 23° F., the difference of 8° being due to cooling by the boiling of the gasoline. The equation given above then becomes : $t_a=226-140 \log p_R$, where t_a is the atmospheric temperature. A series of curves show the observed and predicted vapour-pressures for vapour-lock to occur (for V/L=1) under various operating conditions. There is in most cases a considerable factor of safety.

The change in vapour-pressure with increase in V/L varies considerably with different types of fuels. The extreme case is pentane, the vapour-pressure and vapour-locking temperature of which does not change with V/L. In general, however, the vapour-locking temperature increases markedly with rise of permissible V/L.

The above treatment permits of differentiation between the effects of the fuel-system design and of fuel characteristics, in analysing vapour-lock troubles. The above equation is believed to afford a sufficient margin of safety, for computing the vapour-locking characteristics of most cars. It is still thought, however, that lowering of fuel-temperatures by suitable design of the fuel system is the most effective method of combating vapour-lock troubles. E. B. E.

485. Report on Heavy Oil Engine Working Costs (1931–1932). Diesel Engine Users' Assoc., 13.12.32.—Comprehensive running reports are given for a large number of Diesel engine installations. From the average results of 54 stations, details of all the engines being given, the cost in pence per unit of electricity generated and the percentage of the total cost for the various items are given respectively as follows :—

Fuel 0·237, 45·5% ; lubricating oil 0·037, 7·1% ; water and stores 0·014, 2·68% ; wages (running) 0·137, 26·3% ; repairs and maintenance 0·096, 18·42%. The figures are compared with those for 1922–1923 and show a reduction in fuel consumption from 0·714 lb./k.w. hr. to 0·667 lb./k.w. hr. An improvement in lubricating oil consumption is also noted.

The total cost in pence per unit generated was ·521 as against ·831 for 922–1923, this improvement being accounted for mainly by the increase in average plant capacity from 573 k.w. to 1040 k.w.

The total output for the 232 engines quoted was 46,426,825 units ; 166 engines are between 15 and 499 B.H.P. and generated 42·8% of the total, 48 are between 500 and 1000 B.H.P. and generated 36·8% of the total, and 18 are between 1000 and 2300 B.H.P. and generated 20·4% of the total.

The average overall thermal efficiency works out at 25·5% with an average load factor of 63·5%. J. G. W.

486. Combustion and Injection in High-Speed C.I. Engines. D. A. C. Dewdney. *J. Inst. Petr. Techn.*, 1933, **19**, 213–214.—A précis of a paper that discusses the theoretical and practical aspects of combustion in various types of C.I. engines. G. R. N.

487. Fuel Characteristics in Relation to Pump and Sprayer Action. L. J. Le Mesurier and R. Stansfield. Diesel Engine Users' Assoc., 30.3.33 ; *Engineer*, 1933, **155**, 358.—The research is divided into the following sections : (1) The relation between the flow of oil through pipes and the determination of the loss of head due to this flow ; (2) an examination of fuel pumps to determine the minimum safe working head at the suction side for satisfactory operation ; (3) the effect of change of fuel on the phenomena in the delivery pipe between the fuel pump and spray valve.

From the experimental work given it is shown that the flow through pipes in Diesel engines is practically streamline in character. The loss of head is therefore directly proportional to the rate of flow, the kinematic viscosity, the pipe length and inversely proportional to the fourth power of the pipe bore.

A fall in pipe line pressure below atmospheric will cause air to leak into the pipe through any imperfect joints, although these may not be apparent through leakage of fuel when the engine is standing, and air dissolved in the fuel will be liberated. Free air at the suction side of the pump will tend to cause air locking.

The bulk modulus of a number of fuels was determined in a special apparatus and the effect of temperature was also examined. The bulk modulus of all fuels decreases rapidly with rise in temperature, the effect being greater proportionally than the decrease in density. Therefore, since to a close approximation the velocity of sound in a pipe containing liquid is equal to the square root of the ratio of the bulk modulus to the density of the liquid the velocity of sound in a liquid fuel decreases with rise in temperature.

The pressure waves in the fuel pipe were measured by the R.A.E. indicator using a high viscosity and a low viscosity fuel. The tests were carried out at several engine speeds and with pipes of different lengths. Curves are given showing the pressure variation at the pump and sprayer end of the pipe, and the movement of the sprayer needle valve, on a time base. Increase in fuel viscosity gives rise to higher pressures at the pump end of the pipe.

The lag between the static timing of a fuel pump and the commencement of injection from a spray valve is determined by the time taken for a sound wave to travel from one end of the pipe to the other, and certain other fuel characteristics of which viscosity is the most important. This latter influences the damping of the pressure wave and the residual pressure left in the line from the previous injection.

The rate of opening of the spring loaded needle valve type of sprayer is decreased and the period of injection increased by an increase in fuel viscosity, these effects being more marked with increase in pipe length. Thus excessive fuel viscosity will give rise to bad atomisation and protracted fuel injection, leading to poor combustion and smoky exhaust unless the pumps and sprayers are adjusted to suit the more viscous fuel. J. G. W.

488. Prediction of Oil Engine Performance. G. G. Macdonald. *Mar. Eng.*, 56, 84–5.—Wilding, in a recent paper, demonstrated that the frictional losses in several types of oil engines under review were proportional to speed and almost entirely independent of torque transmitted. The author assumes this to be the case with all types of marine oil engines, and has evolved formulæ for determining the probable performance under conditions of load and speed other than known "datum" conditions.

Equations are given for determining probable h.p. mechanical efficiency and brake fuel consumption, and examples are given showing the application of the formulæ. C. H. S.

489. Factors Affecting the Demand for Gasoline and Crude Oil over the Next Few Years. S. A. Swensrud. *Oil and Gas J.*, 16.3.33, **31** (43), 14.—In an endeavour to formulate some idea of the probable gasoline consumption for the next six years or so the writer has investigated the probable trend of automobile registrations, with which consumption is intimately related. This is indicated by Department of Commerce estimates which show that 92·5% of gasoline is consumed in passenger cars, trucks, buses and taxicabs. Consideration has therefore been given to the number of new cars built and the number disposed of during each of the years 1920–1932. These estimates are prepared from a knowledge of the total registrations for each year and an estimate of the annual production of automobiles. The estimates for 1932 show good agreement with other estimates prepared with the aid of the information obtained by C. E. Griffin, of the University of Michigan, in 1926 regarding the rate of disposal of cars and their average life. Griffin's formula is, therefore, applied to cars produced between 1918 and 1932 to estimate the number of disposals of these cars for the years 1933–1938. Out of a total of approximately 21 million cars available for use at the end of 1932 it is estimated that only about 4½ millions will be in use in 1938, and that the rate of disposal of these cars will be over 3 million per annum for the next three years.

Of recent years the annual production of cars has fallen considerably, *e.g.*, from approximately 4,626,000 in 1929 to 1,300,000 in 1932. Forecasts of future production cannot be made with accuracy, but the author, by taking three assumed production estimates shows, that unless there is a large increase in the rate of production as compared with 1932 figures, the tendency will be for the total number of cars registered to decline appreciably during the next few years. For example, assuming a production of 1½ million automobiles in 1933, 2 million in 1934, and then an increase at a rate which would reach 4 million in 1938, total estimated registrations would decline until 1935–36 and would not reach the 1932 total until after 1938, when allowances are made for the number of cars produced after 1932, which will be disposed of during the period according to Griffin's formula. R. A. E.

490. Starting Tests on Benzole and Petrol and Benzole-Petrol Mixtures. W. H. Hoffert and G. Claxton. *Engineering*, 1933, **155**, 300.—A method is described whereby the ease of starting of motor spirits can be evaluated in terms of the number of engine revolutions to give starting.

Benzole gave easier starting than petrols at temperatures between 10° C. and 20° C. The ease of starting on benzole, however, decreased with reduction in temperature more rapidly than was the case with petrols, and at temperatures below 0° C. starting on benzole became appreciably more difficult than on good quality petrol.

Blends of benzole and petrol at temperatures between 10° C. and 20° C. gave an ease of starting intermediate between those given by the benzole and the petrol. At temperatures of 0° C. to 10° C., however, certain blends of benzole and petrol gave easier starting than either the benzole or the petrol.

Benzole and benzole-petrol blends gave a wider range of mixture strengths at which starting was possible than petrols.

Although certain relationships between the ease of starting on motor fuels and their distillation characteristics have been proposed, such relationships do not permit the ease of starting on blended motor fuels such as are marketed in Great Britain to be predicted. J. G. W.

491. The Use of Vegetable Oils in Diesel Engines. M. Gautier. *Rev. Comb. Liq.*, 1933, **11**, 18–24.—The work described was carried out as a result of the author's conviction that, since Diesel engines by reason of their characteristics were more adaptable for use with varying types of fuels, it was of importance to examine whether it would be practicable to use fuels from a national or colonial source, particularly vegetable oils, without important modifications of the engine.

Previous articles by the author (*Rev. Comb. Liq.*, 1928, **59**; 1929, **61**; 1930, **76** and **77**) describe the preliminary work, the conditions under which this work was carried out and the results obtained. The present work was divided into two definite sections so that a more methodical examination of possible difficulties could be carried out which, in turn, would tend to help toward their solution. The first experimental study describes experiments carried out on a medium-bore high-speed engine using the following as fuels: palm oil, karite butter (Shea butter), peanut oil and castor oil, the object being to pick out the fuel presenting the least difficulties.

The engine chosen was a 4-str. 6-cyl., with cylinder bore of 0·260 metres, and stroke of 0·360 metres, and pneumatic injection, being capable of developing 300 h.p. at 450 r.p.m., and having a compression ratio of 36 and a consumption of 215 gm. when used for gas oil. All the above fuels are stated to have given satisfactory performance, it being necessary to moderately heat the palm and castor oils and the karite butter in order to produce homogeneous mixtures and to reduce their viscosity to a value suitable for pumping and injection purposes. Results of the tests are described, and further work was carried out, using a larger bore and lower speed engine and peanut oil as fuel, this material being easier to handle and eliminating the necessity of preheating treatment.

The second series of experiments, carried out on a 660 h.p. Diesel using peanut oil, gave very satisfactory results. Running and consumption details are given, it being stated that startability from cold was satisfactory. An inspection of the engine after the two series of experiments showed that all parts were in perfect condition, a slight layer of soft, greasy soot being found on the bottom and the sides of the pistons, the top of the exhaust valve and the valve chest, and on the base of the diffusers.

Details are given of bench tests under very severe conditions, using peanut oil of a high acidity (12·79 to 14·53% as oleic acid) and working diagrams

of various days' runs are given. The author concludes that, as the results of the work carried out, it can be stated definitely that vegetable oils can be used satisfactorily as fuels in large-bore engines, these being normally of slow speed, provided a compression ratio similar to that used in the experiments can be maintained. M. M. L.

492. Use of Bitumen in Bridge Construction, etc. F. Greger. *Bitumen*, 1933, **3**, 18–21, 38–40.—For bridges and similar structures, bitumen is used as a luting material. Felt, paper-board, jute webbing and lead foil are employed, generally saturated with bitumen, but in some cases a bitumen coating is applied between layers of the packing material. Care must be taken not to overheat the bitumen as it thereby loses its elasticity. Indirect heating by means of a glycerine bath is recommended so that uniform conditions may be maintained.

A description is given of the various methods of using the above materials with bitumen.

A summary is given of the tentative directions which have been issued for road construction engineers. C. C.

493. Observations on the Cold Construction of Bituminous Coatings. O. Martin. *Bitumen*, 1933, **3**, 31–37.—The author discusses the preparation of road surfaces using "cut-back" asphalt. Figures are given in tables for compositions of the mineral/bitumen mixtures of various types, including the sieve analyses of the mineral matter. C. C.

494. Preparation of Asphalt-Mineral Mixes for Use in the Cold. Part II. T. Temme. *Bitumen*, 1933, **3**, 60–63. (See Abstr. No. 385.)—A further summary is given of various patents. In a typical example for the preparation of asphaltic concrete, the correct proportion of stone and sand is mixed with asphaltic oil (consisting of 50% bitumen and 50% heavy petroleum). Pulverised asphalt containing filler is then added and the whole thoroughly mixed. Solution of the asphalt takes place very slowly, so that the material remains for a long time in a suitable state for application.

The importance and advantages of the cold processes are discussed. It is, of course, necessary to choose stone of suitable nature and size with suitable proportions of bitumen, etc., or the elasticity and therefore the durability of the coating will be unsatisfactory. Manufacturing costs are less than for hot processes for several reasons, *e.g.*, the mixing can be carried out at a central works, only drying of the stone is necessary, and no further heating is required, while only a relatively small proportion of binder is used.

These materials are particularly suitable for applying in cold weather. C. C.

495. Bitumen for Pipe Protection. E. Gerlach. *Bitumen*, 1933, **3**, 52–60.—The question of protecting concrete, iron, earthenware and other pipes against corrosion, etc., with bituminous materials is discussed at length, and a summary is given of the experiences of various workers on this question. In general, bitumen has advantages over tar products. Methods of application include the use of bitumen varnish and emulsions, painting by hand, dipping and spraying. For strengthening the protective coating and to prevent damage in transit and during installation, spirally-wound paper or jute webbing are used.

One case is reported in which a water pipe painted with a mixture of 1 : 1 bitumen and linseed oil has stood up satisfactorily for over 30 years, while such a coating also insulates the pipe against stray electric currents, and it has been shown that it will withstand 6000 volts.

Owing to its elasticity, bitumen is used in the cement jointing material, while it is particularly valuable, with the addition of asbestos fibre, for protecting concrete pipes.

Certain special manufacturing methods for applying the bituminous coatings are described. In one case a deposit is formed electrically from an emulsion. A dipping tank is also described. Considerable difficulty is experienced in forming a satisfactory coating inside of tubes. Details are given of a German patent for concrete tubes. The thickness of the asphalt layer varies from 15–20 mm., according to the diameter of the pipe, and an almost frictionless surface is formed inside. An account is given of experiences with concrete pipes of this type. C. C.

496. Growth of Cracking Curtailing Crude Oil Demand. Anon. *Refiner*, 1933, **12**, 38–39.—The refining industry (U.S.A.) is consuming rather more than 2,000,000 brls. of crude oil per day. The production of cracked gasoline averages about 425,000 to 440,000 brls. per day. The last year has seen an increased utilisation of cracked gasoline, accompanied by a decreased use of the straight-run product. In spite of this fuel oil stocks remain approximately the same. Fuel oil cannot be marketed profitably itself in comparison to returns available from cracking, and the trend is to develop cracking further, at the expense of crude oil throughput. B. C. A.

497. Need for Construction a Paradox. G. Reid. *Refiner*, 1933, **12**, 85–87.—Crumbling prices are a paradox of late 1932 and early 1933, despite a reduction of above ground stocks of crude and motor fuel, accomplished in spite of a declining demand and increases in drilling and crude production capacity. The major influences accounting for this situation are violations of the various proration laws and evasion of gasoline taxes. The demand for cracked gasoline holds at about 460,000 brls. per day, and cracking facilities are being improved and extended. Consumption figures for all oils for 1932 show a decline of 166,433,000 brls., representing 15% of the peak demand for 1929 and 90,830,000 brls., or 8·8%, from the 1931 demand. The consumption of motor fuel in 1932 was 409,204,000 brls., or a decrease of 8·9% from the record demand for that commodity in 1931. The decline in consumption of cracked gasoline, as compared with straight-run, is proportionately less severe.

Amongst the minor products kerosine demand shows an expansion of 0·6%, compared with 1931, total demand being 44,266,000 brls. last year, but U.S.A. demand showed an expansion of 6·3% over 1931, at 33,310,000 brls. Lubricant demand has decreased, being affected by the practice of lubricating oil reclamation, improved systems and prolongation of use, as well as by economic conditions.

The restrictions in production since 1929 have held the output of new crude consistently below requirements, and an 8·1% decrease in production, as compared with 1931, was recorded. Products show an all-round reduction in stocks. B. C. A.

498. Chemical Uses of Ethylene. K. Yoshikawa. *J. Fuel Soc. Japan*, 1933, **12**, 30.—The uses and preparation of ethylene are dealt with, and its formation by the hydrogenation of acetylene, using as catalyst, kieselguhr impregnated with palladium, is described. By this method equal volumes of acetylene and hydrogen are stated to yield over 90% of ethylene and 2–3% of saturated hydrocarbons. W. H. T.

See also Abstract No. 447.

ABSTRACTS.

Class 100. Geographic Occurrence.

499. Operating Refineries in United States. C. O. Willson. *Oil & Gas J.*, 30.3.33, **31** (45), 40.—Tables are given showing the number of distilling and cracking plants: (*a*) in existence, (*b*) actually in operation, and (*c*) shut down, and their daily capacities.

A survey of the number of plants in operation this year in the more important states as compared with those last year, indicates that for the year ending March 15th, 1933, there were 424 operating plants in the U.S. with a daily crude oil capacity of 3,696,410 brls. as compared with 383 plants of 3,665,830 brls. capacity in 1931–32. In 1930–31 there were 397 plants of rated capacity of approx. 3,900,000 brls.

The gain in the number of refineries is attributed to the number of temporary skimming plants built mostly in the East Texas area, due to the unsatisfactory crude oil position. The fact that erection and operation costs of refineries are less than those of a few years ago is encouraging construction, so that when normal conditions return new refineries will be in a better position than older refineries handicapped with obsolete equipment, particularly when considering improvements in design and technique which have led to improved quality of products. C. L. G.

500. 1933 Survey of Petroleum Refineries in United States. Anon. *Oil & Gas J.*, 30.3.33, **31** (45), 41.—Lists are given of the companies and locations of the refineries operating in each of the United States, giving the crude oil distilling capacity, cracking capacity, type of refinery and type of cracking plant. C. L. G.

501. Development and Production Practice. E. Wahlstrom. *Oil Weekly*, 24.4.33, **69** (6), 22.—The Hobbs field has been prorated almost since discovery and some consideration has been given to unit operation. The field has produced 31,216,173 brls. of oil to March 1, 1933. There were 184 wells producing on that date. The field had an original free gas cap which has spread.

The gravity and gasoline content of the gas is increasing.

Bottom hole pressure surveys have been made periodically, and some interesting phenomena observed that have not yet been explained. Work is now being done with a bottom hole oil sampling device for the purpose of determining the amount of gas in solution and other characteristics of the oil.

The water encroachment has been of major proportions only in the upper member of the producing horizon, and formation packers have been used successfully to shut off this water.

Formation packers have proved to be the most successful method of reducing gas-oil ratios.

Forty-acre spacing is now believed to be economically sound. L. V. W. C.

502. Survey of Operating Refineries in Canada. Anon. *Oil & Gas J.*, 30.3.33, **31** (45), 47.—A table is given of the company and location of the distillation and cracking plants in Canada, giving the type of refinery and of the cracking plant. The present total crude oil capacity is 157,875 brls. and the total cracking capacity 60,300 brls. C. L. G.

503. Oil in Chile. C. M. Hardman. *Oil & Gas J.*, 30.3.33, **31** (45), 16.—A recent survey of the extreme south of Chile has drawn attention to its immense potentialities for oil production. There are many seepages of gas

on the mainland and on the Island of Terra del Fuego. The Chilean Government has attempted to drill on the mainland and has started 3 wells, all of which have had a showing of oil and gas. The deepest well (1312 ft.) makes 7 brls. per day of oil of 42 gravity and of a paraffin base, but the equipment is inadequate for real tests. The laws of Chile do not permit foreign companies to operate, but this will shortly be altered by a new bill. There are several applications by American, British and Chilean companies for concessions. Geologists consider that drilling should be taken down to 4000 ft. or more to make a fair test, and it is expected that a start will be made this year. Owing to the failure of the copper and nitrates industries and to the financial depression, it appears probable that the oil industry will be a deciding factor in the future of Chile, given proper Government support for the operating companies. C. L. G.

504. Tectonic Structure of Northern Andes in Colombia and Venezuela. H. de Cizancourt. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 211.—This paper is a discussion of the main tectonic elements of the Andes in Peru, Ecuador, Colombia and Venezuela. The author considers that the accepted idea that the Andes split successively northward into three distinct chains is incorrect, and he considers that the tectonic elements in the north are of different structural types. He divides the northern Andes into three tectonic elements. Firstly, the geosynclinal zone, which includes the Eastern Cordillera of Colombia, the mountains of Perija and Merida and the Caribbean range. This belt is characterised by thick sedimentation in Upper Cretaceous and Tertiary times.

Secondly, there is a rigid massif occupying the depression of Lake Maracaibo, and this is bordered by folded chains.

Thirdly, there is the western foreland which is severely broken by fault systems and is now divided up into successive horsts and graben.

He considers that the oilfield regions are directly related to these tectonic units. All the major fields lie on the borders of the folded geosynclinal area. The paper includes a regional sketch map indicating the distribution of the main tectonic units, and also of the fold systems around the Maracaibo Lake Depression. V. C. I.

505. Magnetic Investigations and Petroleum Possibilities in Central Germany. R. von Zwerger. *Erdöl u. Teer*, 1933, **9**, 205–206.—A brief sketch of the development of geo-magnetic methods is given, and it is suggested that the region between the Harz and the Thuringian Forest is suitable for testing out the methods, on account of the well-known geology of the area, some account of which is given. A geo-magnetic survey in 1931–2 traced the crystalline ridges and their offshoots in this region. The oil-bearing strata must be looked for in the low regions between these ridges in the Thuringian Basin. The earth-movements of the Cretaceous and Tertiary Periods have caused the oil to collect and prevented its migration. The oil reservoirs must be sought in the coastal regions, on the edges of the old high regions and sometimes on the chalk reefs. A boring on the Forstberg has yielded much gas, and it is expected that a second boring, going geologically deeper, will find oil also. A third experimental boring is being made on the West Ettersberg. E. B. E.

506. An Exploratory Survey of the Tertiary Zones between the rivers Urykh and Naltchik (North Caucasus). B. A. Alfiorov. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series A, Paper 13.—The area surveyed lies in the Autonome provinces North-Assetinsky and Kabardino-Balkarsky. The northern part near the mountains consists of a thick

series of slightly disturbed conglomerates of Meotic and possibly uppermost Pliocene age. This transgresses the upper and middle Sarmatian. The thickness of the Sarmatian varies from 170–230 m. Beneath the Sarmatian are the Konk, Karagan and Chockrack-spiralis beds. The Tarkhan horizon with the Pecten denudatus zone is absent, showing an unconformity in the Chockrack. The Mediterranean series totals 200 m. thickness and below are the Maikop beds ranging 400–480 m. At the base of the Tertiary are foraminiferal beds increasing rapidly in thickness in a north-westerly direction (115–350 m.). In the south-eastern part of the area the Tertiaries and upper Cretaceous form a monocline with a north-easterly dip of 20°–30°. The dip is steeper in the younger beds. In the north-west the direction of dip is the same, but the monocline is less steep.

In the centre of the region in the basins of the Psygan-su and Tchereck the strike of the upper Cretaceous beds swings sharply in a sigmoid form round the plunging nose of an anticline. Near Verkhneye-Kojokovo is a slight anticline, which is reflected in the Tertiaries and affects the Argoodan fold. This latter lies in the northern part of the area in the basins of the rivers Lesken, Argoodan and Psygan-su. Its axis plunges eastwards and so in going from east to west, successively older beds are displayed in the gorges cutting into it. The fold is gentle and asymmetrical with the axis turning southwards.

There are no surface shows of oil, and only traces of bitumen have been found by extractions in the Konk and Maikop beds, and the middle horizons of the foraminiferal series. Within the area are springs of mineralised waters, and these have been found to be concentrated alkaline-chloride waters.

G. D. H.

507. Geological Investigations in the Region of the Rivers Imtchin and Uigleikuty of the Northern Sakhalcen Island. M. Perfilyev. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series B, Paper 10.—This is a non-mountainous area and its post-Pliocene deposits show:—Three marine terraces, lithologically alike and undistinguished by fauna. The oldest 68 m. above sea level is eroded at its base; the second is at 45 m., and the third at 18 m. The old river terrace of the Imtchin is 4 m. above sea level.

The Tertiary is divided into four series in descending order:—The Nutovo of fine-grained sands with thin clay intercalations and separated in places from the underlying Ekhabi series by a calcareous sandstone with Pelecypoda and Gastropoda. The 850 m. of Ekhabi is a sandy clayey series with a fauna typical of the mid-Pliocene of Japan (according to Khomonko). There is a gradual transition to the sandy clays of the Okobykai. The underlying series of sands and sandstones with intercalations of stratified clays and brown coals seems not to be quite conformable.

There are two anticlines. The eastern one, the Noglik-Katangly, is fairly symmetrical with two highs, the dome-like Katangly and the lower Noglik dipping gently northwards where the fold merges into the monocline of the Uini-Djimdan area. The western Imtchin anticline is symmetrical and plunges to the south-east. The intervening syncline is faulted longitudinally. Surface shows of oil are known, and in the region of the lower Noglik oil is confined to the bottom of the Okobykai series, and on the Kyivo concession to the middle part of this series. Oil is produced at Katangly. G. D. H.

508. Boya-Dag—Syrtlan-Li. V. Porfiriev. *Trans. Petr. Geol. Res. Inst., Leningrad*, 1932, Series B, Paper 13.—These two anticlines lie 30 km. south of Aidin on the Trans-Caspian railway. The oldest series is an alternation of coarse-grained sands with bands of highly calcareous slate-clays, and can be correlated with the producing complex of the Apsheron Peninsula. This rod

series attains a thickness of 300 m. on the Syrtlan-Li anticline and is overlain by pockets of finely-banded variegated calcareous clays, formerly referred (along with the red series) to the Apsheronian. However, fossils, both animal and vegetable, and layers of volcanic ash have been found which indicate the age as Aktchaghylian. Above this, in places unconformably, lies a sandy clayey series of Apsheronian age with globular concretions of sandstone. The thickness is greatest on the axis of the fold and thins rapidly on the limbs. A thick complex of Apsheronian clays comes next, and then an unconformable series of sands and clays (still Apsheronian). At their base is a ferruginous sandstone, the outcrop of which girds Boya-Dag, but only appears in patches on Syrtlan-Li.

Both anticlines are asymmetrical with the northern limbs, the steeper (dipping at 45°–50°), and each has a close net of faults, considered by earlier writers to be due to laccoliths, but the author believes them an adjunct to the tangential mountain-building movements. On both anticlines the throw of the faults diminishes from the centres of the folds to the edges. The central horst of Boya-Dag is bounded by two faults with a throw of 400 m. Mud volcanoes and gas seeps lie on the joint system at the western end of the fold, and gas escapes from faults near Kara-Bouroun with oil seeps in the neighbouring valley. These are undoubtedly associated with the horst faults, and along the fault a sand lens with dry oil-sands in a clay mass has been observed. In the central horst area are slight faults with oil in the sand layers along the fault lines. Gas, oil seeps and dry oil-sands have been noted on the east. The Eastern Summit is a neck of oil-sand resulting from the flow of gas, oil and water along a fault plane. Oil indications are closely associated with faulting.

On Syrtlan-Li only gas issues have been found. The oil indications of these two anticlines and of some other structures in the sub-Caspian region are secondary, and show that the oil arises from unknown depths. There is evidence that the source rock is not younger than the Jurassic. G. D. H.

509. Belgian Refining Industry. Anon. *Oil & Gas J.*, 30.3.33, **31** (45), 73. —The Belgian Government is attempting to develop a domestic oil refining industry by granting to the home industry tariff protection for products manufactured within the country, in order to assist the general manufacturing industries in Belgium and to be of importance in times of natural emergency.

The Belgian Cracking Co. was created in 1928 by the Centrales Electriques des Flanders du Brabant of Ghent, who are large consumers of coal and operate a low temperature carbonisation plant. The coke is used for firing the boilers of the electric power plant and the tar passed to the Belgian Cracking Co. for processing.

The tar is first distilled in a Borman pipe still, where 300° E.Pt. gasoline, 420° E.Pt. gasoline and residue are made. The heavy gasoline contains phenols and is difficult to treat chemically, but it appears probable that it can be successfully hydrogenated. The residue from the first distillation is passed to a small specially built Dubbs plant operating at 30 atmospheres (instead of the usual 10–18 atmospheres), the capacity of which is 300 brls. per day. A total yield of 50% of gasoline from the initial carbonisation, light gasoline distilled from the tar and cracked gasoline is obtained. The Belgian Cracking Co. also process crude oils and residue, generally of Rumanian origin. Investigation of the possibility of hydrogenating the heavy gasoline from the first distillation and the coke from the cracking distillation is in progress.

The Compagnie Belge du Gaz Catalytique, Brussels, have operated a vapour-phase cracking plant since 1924, cracking gas oil or fuel oil, the gasoline produced being refined by the Gray Towers method. The residue from the operation is an asphalt used for road treating.

The cracked gases are rich in unsaturated compounds and in 1926 the company commenced the manufacture of alcohol. Present monthly production is given as isopropyl alcohol 30,000 litres, butylalcohol 5000 litres, amylalcohol 1000 litres. The stripped gas from the alcohol plant is used for blending with and enriching artificial gas for lighting purposes. The company is also considering the erection of a topping plant and of equipment for the recovery of the ethylene from the rich gas in the form of glycols and chlorine compounds.

The Belgo Petroleum at Terdonck, near Ghent, operate the largest refinery in Belgium of capacity 1200 brls. per day, including a Jenkins' cracking plant and rerun still. East Texas crude is worked up to 375° E. Pt. gasoline, 41° Bé kerosine, diesel oil and fuel oil.

The Purfina Ertvelde, near Ghent, import raw lubricating oil fractions and produce from them a range of automobile and industrial oils, greases, etc. The capacity of the refining plant is given as 20,000 tons per annum.

The Petroleum Products Refining Co., Antwerp, specialise in the manufacture of all grades of pharmaceutical and industrial vaselines. Equipment has recently been installed for the manufacture of lanoline from wool fat.

The large importers have for many years maintained a cartel for the sale of their quotas of gasoline in Belgium. Statistics of the amounts of gasoline, kerosine and fuel and gas oils imported into Belgium for the last four years are given. C. L. G.

510. Petroleum in Burma and India. L. D. Stamp. *Petr. Times*, 1933 **29**, 271–274.—Burma has been very thoroughly surveyed and exploited, and the discovery of a new field seems unlikely. The fields lie in a long line from Indaw in the North, latitude 24° N., to Thayetmo in the South, latitude 19° 15 N, with the richest areas of Yenangyaung and Singu in the heart of the tract. The oil occurs in the Peguan series, the equivalent of the Oligocene and Miocene series of other countries, and at different horizons. Production at Indaw was commenced in 1918, and has shown a steady increase since. Total production to the end of 1931 was about 646,600 brls. The field is a fine, gently folded, open dome, with a considerable gathering ground, and has an area of about a quarter square mile. Oil sands occur at 800–1200 ft. No oil has been found at greater depths, but deep drilling has been hindered by heavy gas. The gas resources, estimated at 12,000,000 cu. ft. per day, are not utilised. The oil is refined at Pantha. At Yenangyat oil has been produced since 1887. It reached its production peak in 1903, but has declined steadily since. Twelve wells were drilled in 1930, and a few in 1931 and 1932, but the initial production per well is less than 15 brls. per day. Structurally the Langwa field may be regarded as the northern part of the Singu field, which is abruptly truncated at its northern end by the Irrawaddy River. Development in the intervening area was obstructed by a sand bank, which was submerged during the rainy seasons until the sand bank was walled in, and the wells then drilled allowed production to rise from a few hundred barrels in 1928 to about 500,000 brls. in 1929. It now seems certain that the oil sands extend under the Irrawaddy River, and schemes are on hand for the erection of derricks in tunnels under the river. At Singu, or Chauk, production commenced in 1902. Production is regulated to the requirements of Rangoon, and thus largely to the output of Yenangyaung. At present the output averages 2,805,500 brls. Recent developments have included electrification of most of the field and the construction of underground storage for surplus gas. Yenangyaung is the principal field in Burma with some 3000 wells producing in 1932. The field has been almost completely developed, but in 1930 the sealing-off of vertical mud veins resulted in the striking of a 100-brl.-per-day sand at 4000 ft.

nearly a mile to the south of the main producing area. Other small fields occur at Minbu, Padaukbin, Yenanma, Akyab, Kyaukpyu. The Assam area of deposition is another gulf almost parallel with, and somewhat comparable in character with, that of Burma. Digboi and the Surma Valley are the principal producing areas. Production in the former field commenced in 1888, and was considerably augmented in 1930 by the discovery of an eastern extension. In Punjab-Baluchistan the present producing field remains the Attock field at Khaur. Conditions here differ from those obtaining in other parts of the Indian Empire in that the oil is believed to have migrated to its present position in the Younger Murree rocks from the Nummulitic Beds of Eocene Age which lie below. Operations have been disappointing on the whole, owing to initially large yields undergoing rapid and considerable dropping off. High pressures have prevented deep drilling. H. G.

511. Reservoir of Persian Oilfields. G. M. Lees. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 229–240.—This paper deals in the main with the conditions of oil storage in the reservoir rocks of the Persian oilfields. After briefly summarising the geological history of the region, the author discusses the broad features of the structural relations of the oil pools and passes on to the question of the reservoir rock conditions. He states that the accumulated evidence indicates that the porous conditions are not caused by dolomitisation, nor are they the result of solution along old landscape surfaces. The reservoir rock is in the main compact, but cores indicate a large amount of general shattering, and it is considered that it is this shattered condition which governs oil movement and gives permeability and storage capacity to the limestone.

The conditions at Masjid-i-Sulaiman and Haft Kel appear to be similar, but at Naft Khaneh production is obtained from limestones in the Lower Fars. V. C. I.

Class 200. Geology and Origin.

512. Migration of Oil and Natural Gas. V. C. Illing. *J. Inst. Petr. Techn.*, 1933, **19**, 229–274.—A lecture with discussion on the fundamental principles that underlie the migration of oil and natural gas. Migration is considered as a two-fold process, primary and secondary, and the influence of various conditions on these oil movements is surveyed. G. R. N.

Class 300. Development and Production.

513. Conroe Brings New Problems in Gulf Coast Development. H. L. Strader and C. P. Parsons. *Oil Weekly*, 17.4.33, **69** (5), 18.—The gas-oil ratios on properly cased wells in the Conroe district range from 400 to 500 cu. ft./brl., and for those with unsatisfactory casing programs the ratios run up to 1000 and 5000 in extreme cases.

Coring is started at about 350 ft. below the top of the Cockfield formation, and is continued down to the casing point. The normal casing program calls for two strings of casing, but where blowouts are experienced three strings are set.

The cementing practice is similar to that carried out at similar depths in the Gulf Coast area.

Soft unconsolidated formations and shallow sands charged with gas cause concern, and the utmost care must be taken in the control of drilling mud and of the mechanical equipment. Double blowout preventers, one manually and the other hydraulically operated, are being used, and a new type quick-closing valve for the mud lines is another development. All the equipment is tested to 3000 lb.

A novel method for drilling into the sand has been devised. After the 7-in. casing has been set a fish-tail bit is attached to a string of 5-in. casing, which is used as the drill pipe, and on the bottom of the casing is a length of screen pipe. A stuffing box arrangement at the surface controls the flow between the 7-in. casing and the drill pipe. From the top of the fish-tail bit runs a length of 2-in. wash pipe with a sleeve at the top end. This arrangement allows the mud to be forced down the bit without by-passing through the screens. When the well starts to flow the fluid passes through the screen, and the pressure releases a sliding sleeve, which opens a set of ports, thus allowing the flow to pass up the casing. L. V. W. C.

514. Completion of Deep Wells. E. V. Foran. *Petr. Eng.*, April, 1933, **4** (7), 18.—The early wells in the Big Lake Pool, Texas, produced on completion a water-white oil, but after several months a dark-coloured oil appeared. In an effort to discover the reason for this a well was deepened by rotary and, unfortunately, part of the producing pay was mudded off.

To overcome this mudding effect a hydraulic rotary and pressure drilling equipment, consisting of a drilling packer, flush jointed pipe and hydraulic snubbing-in equipment was installed. By means of this equipment it was possible for the well to flow whilst drilling proceeded, since the drilling fluid was water only, and for the current rate of flow of oil and gas to be observed at all times. In addition, the depth at which the change from water-white oil to heavy oil took place was indicated.

The productivity of the well and the particular productive characteristics of the formation were disclosed with accuracy. L. V. W. C.

515. Setting Up and Dismantling Rotary Rigs. J. N. Teague. *Oil Weekly*, 10.4.33, **69** (4), 13.—In recent drilling campaigns more attention has been paid to reducing drilling time per well to a minimum. A large share of this attention has been devoted to methods of reducing the dismantling, moving and assembling time.

Gratifying results have been obtained by arranging the equipment to use the shortest lines and fewest connections possible, and by initiating a definite procedure in tearing down, moving and setting up a rig. This plan is the result of experience gained in the East Texas, Thompsons and Conroe fields. The advantage of having a definite plan for this work is obvious, as it makes for better co-ordination and understanding between various departments involved. L. V. W. C.

516. Drill Pipe Stresses. M. Putnam. *Oil Weekly*, 10.4.33, **69** (4), 19.—Following an analytical discussion of the various stresses to which drill pipe is subjected, the conclusion is reached that normal drilling strings are amply strong to resist failure from all stresses that reasonably may be encountered, save bending. It is concluded that flexure of the compressed portion of a drilling string into cavities of even moderate dimensions most reasonably explains the majority of drill-pipe failures not directly occasioned by such causes as actual pipe flaws or damaged threads.

No practical way to completely eliminate failures opposite a cavity is proposed, but use of a high-yield-point steel in the drill pipe immediately

above the drill collar, or oversize pipe used for stiffening, should considerably reduce the number of failures from this cause.

The installation of a number of special instruments for recording modern rotary drilling practice has made possible an analysis of our present methods.

These instruments record such data as drilling weight employed, applied torque, rotary table speed and footage drilled. The data secured also permit of at least an elementary analysis of the various stresses to which drill pipe is subjected. The six principal types of stress are discussed in some detail. The stress problem, however, is so involved that a discussion, at this time, is not offered of the minor stresses set up in a drilling string, nor does it seem advisable to attempt to analyse the effect of combined stresses. It is, of course, realised that ignoring this latter point casts a certain doubt upon the validity of the conclusions reached, but our experience has indicated that, for the time being at least, we can safely neglect this question.

L. V. W. C.

517. Casing Hook Design. W. A. Sawdon. *Petr. Eng.*, April, 1933, **4** (7), 60.—The hook which carried the heaviest string of casing yet run, 6763 ft, of 13⅜ in. pipe equipped with cement collar and whirler shoe, was of the triplex type, providing two separate and individual hooks for the elevator links. The side hooks are so placed to give balanced support to the elevator and are equipped with locking arms, thus combining safety with increased strength. The arms are held mechanically until the elevator links are picked up and are then released to close downwards so that they cannot be opened accidentally.

In the case of the single hook the proportions are increased and better metal is used in their manufacture. The stresses in the multiple hook have been distributed and the swivel bail hook and elevator hooks have been kept to a minimum size.

L. V. W. C.

518. Instruments for Exact Recording of Sub-surface Pressure. D. G. Hawthorn. *Oil & Gas J.*, 20.4.33, **31** (48), 16. (cf. Abstr. No. 322).—This is an instrument of the continuous recording and indicating type. It is electrically operated, requiring 110 volt. A.C. for its operation, and may be permanently installed in the well by attaching a portion of the mechanism to the bottom of the tubing string. An electric cable is run with the tubing string and connects this sub-surface portion of the instrument to the recording means at the surface.

The callibration of the gauges is an important matter, and to carry out this operation a deadweight tester or fluid pressure scale tester may be used.

L. V. W. C.

519. Thread Gauge for Checking Internal Thread Taper. F. B. Gilliams. *A.P.I., Proc.*, Section III., Dec., 1932, 71–72.—This gauge measures quickly and accurately the taper and out-of-roundness of pipe threads, and can be used for pipes of 3-in. diameter upwards. It does not replace the conventional plug gauge, which only indicates interchangeability, but assists in the proper measurement of the thread. The gauge consists of a measuring element with feelers or points of varying lengths, with a guide for each size thread to locate the proper gauging position. The gauge and method of using same are illustrated.

A. O.

520. Control of Drilling Fluid. J. W. Graybeal. *Oil & Gas J.*, 13.4.33, **31** (47), 28.—Gas pressures in the Gulf Coast areas are roughly equal to the hydrostatic head of salt water for any particular depth. These gas pressures are believed to be maintained by water drives, and in that case the general run of gas pressures should be expected to approximate to the hydrostatic

head of water confining them If this is true abnormal pressures in the Gulf Coast could occur only where shallower sands have been repressured by deeper ones through faults. Experience in this district shows that abnormal pressures are rare and that most pressures are normal.

Since a 9·5 lb./gal. mud supplies sufficient hydrostatic pressure to control gas pressures, gas troubles which have developed with muds weighing 11 and 12 lb./gal. must be due either to an improper condition of the mud or to mechanical operations.

The principal reason for these gas troubles has been found to be the swabbing action when coming out of the hole. The more viscous and the more rapid gelling the mud, the greater is the disturbance of static conditions, and the method used to minimise the swabbing action was to use a low viscosity mud.

Increased efficiency will also result from controlling drilling fluids.

Special problems arise where heaving shales, salt water flow, and lost circulation in cavernous areas are encountered, and careful attention is needed if these problems are to be overcome.

The use of the vibrating screen for controlling drilling fluids is a further method for improving the mud. L. V. W. C.

521. Simplification of Flowing Equipment. B. Mills. *Oil Weekly*, 24.4.33, **69** (6), 15.—Christmas trees are now installed under the derrick floor and the equipment used has been considerably simplified in the Kettleman Hills area.

A typical gas trap installation at a single well includes two high pressure, one low pressure and one vapour trap. With a decline of pressures and production this installation may be used for a number of wells flowing as one unit.

A different type of trap arrangement has been considered. This will consist of high pressure traps, special pumps, low pressure traps and storage tanks, the flow being through the equipment in that order.

The standard equipment for a single well is a small individual high and low pressure trap. L. V. W. C.

522. Well Pumping Equipment Problems. H. Ledeen. *Petr. Eng.*, Mar., 1933, **4** (6), 34; Apr., 1933, **4** (7), 39.—This paper is a mathematical study of pumping problems. The variations which can be made in the pumping equipment to increase efficiency or reduce costs are examined in detail. L. V. W. C.

523. Two Stage Separators. Anon. *Oil & Gas J.*, 27.4.33, **31** (49), 12.—High pressure separators in conjunction with low pressure units are being put into more general use in Conroe.

The flow from the wells is run to the H.P. separator, which holds the pressure to facilitate the extraction of oil. A pressure of 350 lb. is maintained by a relief valve located in the vent line from the top of the separator.

An automatic pilot valve controls the discharge rate of the fluid and the maintenance of fluid level in the low pressure separator into which the recovered fluid is dumped. From this separator the fluid is run directly to storage. L. V. W. C.

524. Orifice Fittings in Flexible Separators. W. A. Sawdon. *Oil Weekly*, 1.5.33, **69** (7), 23.—Gas measurement is a necessity, particularly in those fields where gas-oil ratio regulations are in operation, and the orifice fitting has done much to overcome the disadvantages which attached to the orifice plate.

By the installation of an orifice fitting the differential can be kept within the range where it will give the closest reading and the continued use of the

wrong size orifice is eliminated. The change of orifice is made without interruption of the service, and plates can be readily cleaned when this is necessary.

By means of batteries of separators and tanks maximum flexibility is possible. A change of volume of gas passing out of any one separator may occur, but the orifice fitting will maintain flexibility by providing the proper orifice size to measure the volume discharged by the separator.

A by-pass around the meter setting is eliminated by the orifice fitting.

Wherever the volumes of gas coming from the traps are varied by operating conditions, as by the hooking up of new wells, orifice fittings are practically a necessity. L. V. W. C.

525. Determining Potentials. J. S. Hudnall. *Oil Weekly*, 1.5.33, **69** (7), 16. —Such factors as sand penetration, mechanical equipment, bottom hole pressure and heavy withdrawals in the early life of the field have been shown to be of minor importance in determining the potential in the East Texas Field.

An effective factor in determining potential is permeability, and oil reserves or sand thickness are more intimately associated with potential than all other factors.

On the east side of the field there was a decline in production during the second hour as compared with the first, whilst on the west side the production increased. This is assumed to mean that the water is replacing the oil on the west, but has little or no effect on the east side. Thus a proration schedule utilising potential would permit the wells on the west side to produce more oil than the average of the remainder of the field. This would be a conservation measure, and would also be more equitable to the west side operations. L. V. W. C.

526. Progress of Bottom Hole Choking. H. C. Otis. *Petr. Eng.*, Apr., 1933, **4** (7), 34.—Bottom hole choking has been found very effective, in combination with surface choking, in restricting the delivery rate of wells, in steadying the flow, in lowering bottom hole pressures to prevent water coning, in lowering gas oil ratios where the limited supply of available gas was made to work more efficiently and in enabling pumping wells to be produced by flowing.

In the wells where the gas-oil ratios have been lowered, the bottom hole working pressures originally employed were in excess of those necessary for efficient flow, and consequently no lowering of the gas oil ratios was to be expected by more efficient utilisation of the gas in lifting the oil.

It was found from a series of tests that it is possible to choke to lower rates of flow with bottom hole chokes than with surface choking only, and that there is a limit to the amount of choking which can be successfully applied.

If flow were cut off at the choke when using a bottom hole choke, which would permit flow of maximum efficiency, it was reasoned that the well would have to operate against a lower pressure when the choke was again opened. This was proved to be the case. A new airlift or gas lift device has been designed of the form of a removable bottom hole choke, and the high kick-off pressures so often required are unnecessary with this apparatus.

A combined bottom hole choke and valve has been successfully applied to the operation of gas wells. By the use of this bottom hole differential pressure regulator, complete flexibility in the rate of deliveries has been made possible and freezing at the siphons has been eliminated.

The apparatus consists of a valve, so weighted that it tends to close against the upward flow, connected to the choke in place of the bean. Tests must be

made before the installation of the valve to discover the delivery pressure at which freezing in the system will start.

The effective pressure at the choke can then be reduced by adjusting the spring in the apparatus, so that the requisite amount of pressure is absorbed at the choke in working against the spring. The effective pressure will be reduced to an extent equal to the difference between the bottom hole working pressure and the pressure on top of the choke, which will result in a delivery pressure no higher than that which will cause freezing in the system.

L. V. W. C.

527. Acid Treatment of Oil Wells. K. C. Sclater. *Petr. Eng.*, Apr., 1933, **4** (7), 24.—The use of acid for the treatment of small producers is placing old properties on a more secure paying basis.

Corrosion of the casing and other metal parts by the acid used can be obviated by the use of inhibitors.

It is stated that from 60 to 90% of the total pressure drop from the outer drainage limits of the well to the hole actually occurs in the first 10 ft. from the well, and thus by opening up the formation, by the use of acid, under a pressure that is in proportion to the calculated radial flow pressure drop, a straight line pressure gradient may be obtained and hence an increase in production from the well.

Dolomitic formations give a little more trouble than those formations containing 60 to 90% calcium carbonate. Wells containing 98% of calcium carbonate require a high pressure in order to get a rapid dispersion of the acid treatment.

It is confidently asserted that once a suitable chemical treatment for both sand and lime is perfected, the effective drainage area of any particular well will be increased in all probability from 30 to 50%.

In addition to opening up the formation, acid compounds have also been used for dissolving the paraffin. These compounds act in such a manner that the paraffin does not form a sticky plastic mass, which is liable to clog the face of the pay sand.

It has been found that the average increase in production on a well that has been properly treated is about three times what it was before treatment.

L. V. W. C.

528. Conservation of Oil and Gas. J. O. Lewis and H. F. Wright. *Oil & Gas J.*, 27.4.33, **31** (49), 14.—In a competitively operated field it is not possible to attain complete conservation of gas, but proration by the use of bottom hole pressures will give a greater incentive toward such conservation. A forecast of gas reserves and available supplies is made possible and operators are encouraged to examine the various directions in which gas can be utilised. Modification of the proposed plans made is necessary due to inequities, but bottom hole pressures, it is believed, will enable compensations, to which property owners may become entitled, to be determined. L. V. W. C.

529. Repressuring Oil Sands. S. F. Shaw. *Petr. Eng.*, April, 1933, **4** (7), 29.—This article is a summary of the known facts on repressuring.

L. V. W. C.

530. Keeping Waste Oil from Well Head. Anon. *Oil Weekly*, 24.4.33, **69** (6), 20.—As a means to prevent waste and at the same time maintain the lease in a clean state a novel method has been adopted.

A tee is fitted into the lead line running from the tubing head and a full swing connection is placed in the continuation of this lead line which extends over into a drum placed near the well.

The lower end of the drum is equipped with a flange so that another line may be made up leading from the drum to the casing head. This line may be closed off from the drum by a valve when repairs to the well are required. Gravity permits the oil in the drum to flow back into the casing head to be recovered by the pump. L. V. W. C.

531. Patents in Drilling Apparatus.—R. Wilkins. E.P. 361,483. Well drilling plant.

W. B. Wigle and E. P. Strause. E.P. 361,961. Rotary jar.

National Supply Co. E.P. 364,135. Control head for wells.

National Supply Co. E.P. 364,671 and E.P. 364,672. Cooling device for draw works drum brake rims.

A. E. White. E.P. 365,197. Casing spears.

W. D. Shaffer. E.P. 366,132. Control gate for wells.

C. D. Maze. E.P. 367,858. Blasting cartridges for use in increasing the output of oil wells.

Anglo-Persian Oil Co. and E. D. Scott. E.P. 368,871. Oil saver for cable tool wells.

H. Lembeke and P. Schmidt. E.P. 368,957. Turbine driven earth boring drill.

F. H. Rogers. E.P. 369,379. Well reamers.

National Supply Co. E.P. 370,366. Well drilling plant.

National Supply Co. E.P. 370,713 and E.P. 376,305. Cooling device for draw works drum brake rims.

R. S. Minor. E.P. 376,856 and E.P. 377,288. Crown block for derricks.

National Supply Corporation. E.P. 377,344. Rotary drilling machine with hydraulic feeding means.

National Supply Corporation. E.P. 377,378. Gripping means for rotary well drilling apparatus.

L. M. C. Seamark. E.P. 378,030. Means for forcing casing or drill pipe into a well against the pressure in the well.

Phillips Petroleum Co. E.P. 378,282. Flow Head.

W. G. Bottom. U.S.P. 1,902,828, 28.3.33. Well bore angle detector and recorder.

A. L. Hampton. U.S.P. 1,902,851, 28.3.33. Overshot.

L. M. C. Seamark. U.S.P. 1,902,906, 28.3.33. Pressure operated blow-out preventer and casing head equipment.

W. C. Bailey. U.S.P. 1,902,941, 28.3.33. Rotary bit.

J. F. Mellor. U.S.P. 1,902,968, 28.3.33. Earth boring apparatus, consisting of a cylindrical element in combination with a motor. Fluid under pressure is supplied by pipe to the cylinder in which a valve mechanism is adapted to open under predetermined pressure. The valve mechanism is in two parts in contact, one part being supported by the pipe which supplies the fluid. The two parts are relatively movable to open and close a passage between them. The valve mechanism fluid is forced into a pressure receiving head for the necessary exertion of pressure.

C. Eurit. U.S.P. 1,903,034, 28.3.33. Straight lift beam hanger for oil well pumping rigs.

R. Giesey. U.S.P. 1,903,232, 28.3.33. Deep well drill.

J. W. MacClatchie. U.S.P. 1,903,467, 11.4.33. Drill pipe protector.

W. I. McLaughlin. U.S.P. 1,903,512, 11.4.33. Instrument of the plumb-bob type for recording inclination.

A. Anderson. U.S.P. 1,903,969, 18.4.33. Bore hole surveying apparatus.

C. L. Powell and H. R. Smith. U.S.P. 1,904,249, 18.4.33. Portable rotary drilling machine.

W. Sheldon. U.S.P. 1,904,256, 18.4.33. Hydraulic rotary drilling machine.

B. H. Davis. U.S.P. 1,904,275, 18.4.33. Bridging block for wells.

J. L. Larkin. U.S.P. 1,904,317, 18.4.33. Well casing shoe.

H. A. Pippin. U.S.P. 1,904,522, 18.4.33. A well drilling apparatus, consisting of a casing containing two axially aligned motors, having their armatures rotating in opposite directions. Attached to the armature shafts are two bits rotating in opposite directions.

L. H. Ricker. U.S.P. 1,905,058, 25.4.33. Swab plunger.

F. L. Scott. U.S.P. 1,905,066, 25.4.33. Rolling drill cutter.

R. C. Lunsford. U.S.P. 1,905,116, 25.4.33. Mounting for acid bottles.

E. Craig and W. O. Cooper. U.S.P. 1,905,158, 25.4.33. Drill pipe protector.

H. W. Fletcher. U.S.P. 1,905,165, 25.4.33. Disc. bit.

W. J. Williams. U.S.P. 1,905,200, 25.4.33. Mechanism for recording rotation of a well surveying instrument.

J. L. Badgett. U.S.P. 1,905,208, 25.4.33. Sand tester.

W. I. McLaughlin and R. G. Widemeyer. U.S.P. 1,905,299, 25.4.33. Instrument for recording inclination in a well.

H. B. Webster. U.S.P. 1,905,546, 25.4.33. Instrument for recording inclination in a well.

W. M. Smith and K. W. Haley. U.S.P. 1,905,573, 25.4.33. Oil well surveying instrument.

B. Travis. U.S.P. 1,905,577, 25.4.33. Cat line spool.

D. R. Knowlton and W. J. Critis. U.S.P. 1,905,592, 25.4.33. Control device for wells.

O. Hammer. U.S.P. 1,905,860, 25.4.33. Well reamer.

F. A. Galish. U.S.P. 1,906,056, 25.4.33. Under-reamer. L. V. W. C.

532. Patents on Crude Oil.—C. Hinrichs. U.S.P. 1,901,163, 14.3.33. Resolution of crude oil emulsions by treatment with a product resulting from the heating of ricinoleic acid.

L. L. Davis. U.S.P. 1,901,228, 14.3.33. Removal of water soluble material (salt) from crude oil by the addition of water and the heating of the mixture. W. H. T.

Class 400. Transportation, Storage and Distribution.

533. Methods for Determining the Total Acidity of Soils. I. A. Denison. *Bur. Stand. J. Res.*, 1.3.33, **10**, 413.—Existing methods for the determination of soil acidities are not entirely satisfactory. While figures are obtained which are adequate for the needs of the agricultural industry, they do not always represent the total acidity. Recent investigations have shown the relationship between total acidity and the rate of pitting of buried metals, and between the base exchange capacities of certain ceramic clays and their physical properties. A method utilising the principle of electrometric titration has been successfully applied to the estimation of total acidity of soils. Titration curves of extracts from a large group of diverse soils showed, with few exceptions, fairly well marked inflections from which the acidity of the

soil could be estimated readily. The method was found to be unsuitable for organic soils, which absorbed more alkali than was required to neutralise the acidity. Values obtained by two other methods—namely, that of Hassink and that of Page and Williams, gave results which suggest their adoption for the estimation of the acidity of soils, the titration curves of which do not show an inflection. The methods depend on the fact that the quantity of ionizable hydrogen in a soil is equal to the difference between the total quantity of replaceable bases which the soils can absorb, expressed as equivalents, and the quantity of bases actually present. The relation is usually expressed thus: $V = 100\ \frac{T-S}{T}$ where V = degree of unsaturation of the soil with respect to replaceable bases, T = absorption capacity for exchangeable bases in milligram equivalents, S = total content of absorbed bases present in soil in milligram equivalent, T—S = absorbed hydrogen. H. G.

534. Corrosion of Oil Tankers. N. B. Musser. *A.P.I. Proc.*, Section III. Dec., 1932, 51–62.—This paper is a summary of data submitted to the Sub-Committee of the A.P.I., which is investigating the question of oil-tanker corrosion. Tables are given covering a large number of drill-tests, which indicate that an average rate of penetration of 0·006 in. per year per surface exposed to corrosive oil service is obtained. From this figure, it is stated that an ½in. plate exposed on both sides to gasoline or similar corrosive oils would be wasted by 30% in just over 12 years. Horizontal parts of the structure appear to be more subject to attack than vertical. A large tanker, after carrying 100 cargoes, will need extensive structural repairs. The corrosive rate of sour crudes, although appreciable, is not so great as gasoline. Strains are believed to accelerate corrosion, as the highest rates of penetration have been noted amidships.

Protective coatings for the interior of oil tanks are mentioned, but apparently little success has been obtained in this direction. Regarding seawater corrosion on the external surfaces of hull plates and rivets, it is agreed that red-lead paints are unsuitable for application underwater or on water level because of the slow rate of drying, and tests are being made with quick-drying paints in which linseed oil is displaced as a vehicle by synthetic resins.

Redesign of hull structures is suggested to secure a more uniform life of the various parts; also re-arrangement of structural details to permit the application of cheap washes, which can be applied by the crew to the best advantage. W. A. W.

535. Steam Heating of Oil-Storage Tanks. A. H. Hayes. *Mech. World Eng. Rec.*, 1933, **93**, 210–211.—Three methods of heating are discussed: the first employs a steam trap to drain away condensate, the second has an open discharge to atmosphere, and the third is a circulating system from which condensate is removed by a trap. The heat balance is investigated in each case and the results compared. Power and Fuel Bull.

536. Maximum Permissible Speeds of Flow in Gasoline Lines. B. Muller. *Erdöl u. Teer*, 1933, **9**, 222–3.—This is a description of experiments by O. Sander, from a recently published book, and deals with the ignition of gasoline by static charges caused by high rates of flow through pipes. It appears from the collected results that the maximum permissible speed is 4 metres/sec.

A number of results on the speed of flow of benzine through pipes of different diameters, with a given head, are given. E. B. E.

Class 500. Properties and Their Determination.

537. Determining the Refractive Index of a Liquid. S. C. Gladden. *Rev. Scien. Inst.*, 1933, **4**, 231.—A simple method of measuring the refractive indices of transparent liquids is described, in which a watch glass serves to give the liquid the form of a plano-convex lens. The image of the maker's trade mark on an incandescent lamp is focussed by means of the liquid lens on a moveable screen mounted on a vertical optical bench. By using the image equation, $1/a + 1/b = (n-1)\ 1/R$ (where a and b are the object and image distances respectively, n the refractive index of the liquid and R the radius of curvature of the convex surface of the liquid), the refractive index, n, may be determined. A Wallace type G colour filter is employed to give results comparable with the values of n determined with Na light. Results are given for distilled water, toluene, benzene and carbon tetrachloride. The greatest source of error lies in the vibration of liquids of low viscosity, which introduces difficulties in focussing. W. H. T.

538. Measurement of the Thermal Conductivity of Mineral Oils. M. Louis and M. Carrette. *Ann. Des Comb. Liq.*, 1933, **8**, 133–139.—The authors draw attention to the difficulties involved in measuring the thermal conductivities of oils and the apparently contradictory statements in the literature. The method used by the authors to overcome the usual experimental difficulties, consists in allowing heat to flow from a source at a constant temperature through a layer of oil which floats upon a layer of water. The underside of the water layer is in contact with a surface maintained at a constant lower temperature. After 6 or 8 hours a steady temperature gradient is set up, and since the amount of heat passing through the two layers is equal, then the thermal conductivity of the oil can be expressed in terms of the thermal conductivity of water.

The temperature of the body of the oil is measured in two planes, T_1^1 and T_2^1 by special flat thin thermocouples, and similarly the temperature of the water, T_1 and T_2 where the distance apart of the planes is equal.

The thermal conductivity of the oil equals that of water multiplied by

$$\frac{T_2 - T_1}{T_2^1 - T_1^1}$$

Results are given for a thin, medium and heavy oil, and it appears that the conductivity at a given temperature decreases with increasing viscosity, and for a given oil decreases with increase in temperature. For example, at about 42° C, the conductivity of the spindle oil is 0·00038, decreasing to 0·00035 at about 62° C. The results are estimated to be accurate to 10%. W. E. J. B.

539. Simple Method for Accurate Determinations of Vapour Pressures of Solutions. D. A. Sinclair. *J. Phys. Chem.*, 1933, **27**, 495.—The method is based on that of Bousfield, in which open cylindrical glass vessels containing different solutions are placed in a desiccator, which is evacuated and placed in a thermostat for two or three days. By this time, the solutions will have come into equilibrium by distillation of solvent, and hence each will have the same vapour pressure. The concentrations are determined by weight and, if accurate data are available for one solution, equally accurate values may be deduced for the others. The author has adapted the method to bring the solutions to equilibrium as regards vapour pressure in a shorter space of time, by using silver-plated copper dishes mounted on a copper base

rocked in an evacuated desiccator in a thermostat. Values by the improved method may be obtained with an accuracy of 0·3% or less for solutions of concentration above 0·1 M. W. H. T.

540. Significance of A.S.T.M. Distillation Curve. M. G. Blair and R. C. Alden. *Ind. Eng. Chem.*, 1933, **25**, 559.—Previous research relating to the A.S.T.M. distillation curve of motor fuels is briefly discussed.

The method developed by Brown for estimating the performance characteristics of a fuel is given in outline, and consists essentially in placing five vertical axes, at various percentages distilled from the fuel, along the path of the distillation curve. Each axis is graduated in ° F. In using this chart the A.S.T.M. curve is plotted across the five axes, and the temperature reading at its intersection with each axis is noted. From the figures so obtained an indication is obtained of (*a*) possible starting (8%); (*b*) easy starting (10%); (*c*) quick warming of characteristics (35%); (*d*) good acceleration, without choke, steady driving (60%). The fifth axis is provided with two temperature scales, indicating: (*a*) the atmospheric temperature at, or above which difficulty from crank-case dilution, if it occurs at all, will be limited to that part of the warming up period, during which it is necessary to use the choke; and (*b*) the atmospheric temperature at or above which there will be loss of power as a result of a too rapid vaporisation of fuel in the system.

From the A.S.T.M. curve a means has been devised for estimating graphically the butane, pentane, hexane, heptane, and heavier hydrocarbon content of motor gasolines. Comparison of the values obtained by this graphical method with the results obtained by laboratory analysis were in excellent agreement.

The Reid vapour pressure of gasolines has also to be calculated from graphical considerations, and in addition the minimum temperature at which incipient vapour lock might be expected has to be calculated.

Charts illustrating the above methods are presented. H. E. T.

541. Effect of Viscosity on Friction in the Region of Thin Film Lubrication. O. C. Bridgeman, S. A. McKee and F. G. Bitner. *A.P.I. Proc.*, Section III., Dec., 1932, 154–158.—This paper describes experiments made with a modified Herschel "oiliness machine" (for description of original, see Instruments, Sept., 1930, p. 597). This machine measures the coefficient of friction between three steel balls, which slide on a flat disc of bearing metal. The modified apparatus, designed to allow a wedging action in the oil film, contained three steel rolls (from a tapered roller bearing) which replaced the three steel balls. These rollers slid and did not roll, on the top of a flat ring about ¼ in. wide, which rotated in a horizontal position. Provision was made for operating at various speeds and loads. Two flat rings were constructed, one of A.S.T.M. No. 1 Babbit metal, and the other of mild steel. These were finished in the lathe, but not lapped. Each specimen ring was run in by continuous operation until the same friction-speed curve was obtained when running from high to low speeds and back again.

An experiment is conducted by allowing oil to drop upon the top surface of the specimen ring at the rate of two drops a minute, with the ring rotating at some desired speed. The relative position taken up by the three rollers, which are fixed in a holder, is indicated by means of a pointer and scale, the relative rotation of the holder being opposed by coiled springs. These springs are adjusted such that the pointer reads the coefficient of friction direct on the scale. When operating at a constant speed, this value does not change with time if the true equilibrium value has been obtained.

Friction data were obtained at room temperature with four mineral oils, viscosity range 42–9340 centipoises at 25° C., with castor and with lard oil. These oils were used at different speeds and loads with both the steel and Babbit rings. With the Babbit specimen and considering speeds below 2 r.p.m., the coefficient of friction decreased as the oil viscosity increased. As the speed is increased, for any oil, the curves of friction against speed show minima, *e.g.*, with an oil of 3120 centipoises viscosity at 25° C., the coefficient of friction is about 0·24 at extremely low speeds, falling sharply to 0·06 at about 6 r.p.m., then increasing slowly to about 0·10 at 30 r.p.m.

However, for the four mineral oils used, all the experimental data fitted on one curve when the coefficient of friction was plotted against ZN, *i.e.*, viscosity (centipoises) X speed (r.p.m.). This curve is similar in shape to the individual friction speed curves, and indicates that in the thin film region of lubrication the coefficient of friction decreases as the viscosity is increased, the reverse being true in the region of thick film lubrication.

Data obtained on a journal bearing are quoted, which indicate that in the thick film region, characteristics of the oil other than viscosity are without effect on the coefficient of friction, *e.g.*, mineral, lard and castor oils all plot on the same ZN/P graph. In the region of thin film lubrication, however, "oiliness" plays an important part, and the friction—ZN curves for castor and lard are below the ZN curve for the mineral oils.

The coefficient of friction in the thin film region was apparently independent of load. W. E. J. B.

542. Fractional Diffusion (Application to the Analysis of Fats and Mixtures of Hydrocarbons of High Molecular Weight). E. André. *Ann. des Comb. Liq.*, 1933, **8**, 111–127.—An apparatus is described for the fractional extraction of a liquid, *e.g.*, fatty or mineral oil, by a solvent with which it is immiscible. The oil is placed in a long cylinder, to the bottom of which passes a tube down which condensed drops of solvent fall, and pass up through the bulk of the oil, which may contain fragments of thin glass tube to break up the globules.

The more soluble portion of the oil dissolves in the ascending drops, which collect in an upper layer, and the excess over a constant level is returned to a boiling flask in the same way as in the Dean and Stark Water Apparatus. At intervals, the solvent in this flask is changed. Each portion is evaporated separately, and a series of fractions thus obtained.

Complete removal of solvent from the latter is effected by heating on a water bath under reduced pressure—finally adding 2 ml. of water, which assists removal of the last traces.

By repeating the process on the separate fractions a sample may be divided to any desired extent, and by determining the constants an indication of the chemical composition of the sample can be obtained.

Typical results are given for three fatty oils (including castor) and a petrolatum.

The method is applicable to the investigation of mixtures of hydrocarbons of high molecular weight, *e.g.*, mineral oils. In this connection, the method should be particularly suitable for studying the optically active components of these oils as racemisation should be avoided. C. C.

543. Standard Conditions for Bomb Calorimetry. E. W. Washburn. *Bur. Stand. J. Res.*, 1933, **10**, 525–558.—An examination of the conditions existing in bomb calorimetry shows that the heat of combustion per unit mass of substance burned is a function of the mass of substance used, initial O_2 pressure, quantity of water in the bomb and the volume of the bomb.

To eliminate the effect of these unstandardised variables, it is suggested that every determination be first corrected (where necessary) to give the change of intrinsic energy for the pure isothermal reaction under a pressure of 1 atmosphere for reactants and products.

From this value the heat of the pure reaction at a constant pressure of 1 atmosphere can be calculated.

The magnitude of the correction varies from a few hundredths of 1% up to several tenths of 1%.

Tables and equations are given, and from these the heat measured in the bomb can be corrected to any desired standard temperature. D. L. S.

544. Synthesis of Benzaldehyde from Benzene and Carbon Monoxide under Pressure. J. H. Holloway and N. W. Krase. *Ind. Eng. Chem.*, 1933, **25** (1), 497.—Benzaldehyde has been synthesised from benzene and carbon monoxide, using aluminium chloride as a catalyst, the method employed being substantially an application of that due to Friedel and Crafts.

The various factors which influence the yield of benzaldehyde obtained and the course of the reaction have been investigated in some detail. In addition the method appears to present distinct commercial possibilities.

H. E. T.

545. Behaviour of Trimethylene Sulphide in Heptane and Naphtha Solutions. R. W. Bost and M. W. Conn. *Ind. Eng. Chem.*, 1933, **25**, 523–526.—The action of trimethylene sulphide (in pure normal heptane and three different naphthas as solvents) on various reagents—*viz.*, mercuric chloride, methyl iodide, potassium permanganate and 30% hydrogen peroxide in glacial acetic acid—was investigated when stable derivatives were formed. A solution of bromine in carbon tetrachloride gave a product which decomposed readily at −15° C. Mercuric iodide did not react. Nitric and hydrochloric acids gave highly polymerised products, and the polymers formed with the former acid had colloidal properties in an aqueous medium. This sulphide differs from tetramethylene and pentamethylene sulphides in its behaviour with concentrated hydrochloric and nitric acids. W. S. E. C.

546. Thermal Decomposition of Isobutane into Primary Products. L. F. Marek and M. Neuhaus. *Ind. Eng. Chem.*, 1933, **25**, 516–519.—In the pyrolysis of isobutane at 600° and 650° C., the primary dissociation products were hydrogen and isobutylene, methane and propylene and ethane. The velocity constants for the thermal dissociation rates at these two temperatures were calculated, also those for individual primary dissociation reactions of ethane, propane, *n*-butane and isobutane over a temperature range of 550° and 650° C. Curves are given showing the amount of each product formed at 600° and 650° C. W. S. E. C.

547. Determination of Carbon Dioxide in Continuous Gas Streams. W. M. Martin and J. R. Green. *Ind. Eng. Chem.*, Anal., 1933, **5** (2), 114–118.—This investigation has been carried out during an attempt to study the effect of petroleum spray oils on the respiratory activity of growing plants. A short review of methods for determining carbon dioxide is appended. The authors have amplified the titration method where the carbon dioxide is absorbed in a standard solution of barium hydroxide and the carbonate determined by a single titration. A diagram of the constant temperature respiration apparatus is given. It consists of a respiration chamber, with thermo-regulator, carbon dioxide absorbers, and is provided with a source of carbon dioxide-free air. Milligan absorbers were employed, but were found not to be completely efficient in carbon dioxide removal, and solutions of

barium hydroxide stronger than 0·105 N could not be used on account of the excessive volume of standard acid required in titration. A spiral absorber, described, was finally developed and proved highly satisfactory. Titrations were made in a described apparatus, using phenol phthalein or preferably thymolphthalein as indicator. Addition of barium chloride to the barium hydroxide solution reduces the solubility and hydrolysis of the barium carbonate; figures are given to show the increased efficiency obtained in absorption using up to 0·80 N barium chloride concentration. The authors' data show that the efficiency of absorption of carbon dioxide from a continuous gas stream is determined by the concentration of the absorbing liquid, by the rate of flow of gases and by the design of absorption apparatus. R. E. D.

548. 1. 1-Dimethylcyclopentane and 2-Methylhexane in a Mid-Continent Petroleum. J. H. Bruun and M. M. Hicks-Bruun. *Bur. Stand. J. Res.*, 1933, **10**, 465–473.—An Oklahoma crude was fractionated into 1° C. cuts and the fractions 85–95° C. nitrated to remove toluene. By further fractionation a cut 90–91° C. was obtained which, from its refractive index and molecular weight, was shown to consist mainly of 2-methylhexane. Purification by simple equilibrium melting was unsuccessful, as the material formed a glassy substance on freezing. Extraction with various solvents likewise failed.

Eventually the material was purified by cooling with CO_2 slush, mixing with liquid propane, further cooled with liquid air, and slowly poured into liquid methane when crystals separated.

A small amount of liquid 87–88° C. was obtained by the initial fractionation, and on further distillation a portion boiling at 87·5° C. was collected. From its refractive index and molecular weight, it was concluded that this was impure 1, 1-dimethylcyclopentane.

The specific gravity, refractive index, boiling and freezing points and molecular weight of the isolated hydrocarbons were ascertained and compared with the corresponding values of the synthetic hydrocarbons. The infra red absorption spectrum of 2-methylhexane was also determined.

It was found that the crude contained about 0·25% of 2-methylhexane, and not more than 0·04% of 1, 1-dimethylcyclopentane. D. L. S.

549. Wide-Range Variable Gas Flow Meter. B. W. Bradford. *J.S.C.I.*, 1933, **52**, 363–4.—The usual form of flow meter having a fixed choke orifice has a scale contracted approximately according to an inverse square-root law, and its sensitivity increases with increasing flow-rates. The useful range is somewhat less than a tenfold variation of flow-rate because there are difficulties of reading accurately small pressure differences in the U-tube oil manometer.

The author devised a flow meter which has a linear scale throughout a greatly extended range of flow-rates and an improved sensitivity at low rates of flow. It employs a constant pressure difference so that the accuracy with which a stream of gas can be maintained constant is independent of the value of flow-rate throughout the instrument's range (which covers a 100-fold variation). Dimensions are given for a model working over a range of 0·1 to 10·1 per minute, the scale of flow rates being linear from 0·1 to 8·1 per minute.

The important feature in the meter is a glass constriction (minimum diameter 1·5 mm., widening to a diameter of 4 mms. in a distance of 4 mms.) accurately centered. In this moves a metal spindle, one end of which is shaped into a cone of pitch equal to that of the glass constriction, both being ground in with carborundum paste.

The middle portion of the spindle is threaded and screws into a sleeve fixed by cement or wax in the glass tube immediately above the constriction and below a female ground glass joint. In the latter moves a glass male attached to a glass tube in which is fixed a piece of metal having a narrow hole eccentrically placed and a central equilateral triangular hole cut in it. In this fits the triangular-shaped top of the spindle so that rotation of the male portion of the joint rotates the spindle, which is free to move vertically. To the female joint is fixed a cylindrical scale on which moves a pointer attached to the male portion of the joint.

Provided that backlash has been eliminated, the calibration of the meter remains constant. If oil is undesirable as a manometric liquid, a variable-aperture meter operated with constant pressure-difference may be readily adapted for use with a sensitive mercury manometer of the differential air-bubble type. C. I. K.

550. Chemical Composition of Petroleum. A. Sachanen and R. Wirabianz. *Erdöl u. Teer*, 1933, **9**, 170–172, 187–189, 202–203, 220–222.—The authors aim to give as complete as possible a picture of the group composition of petroleum, without regard to individual compounds. A number of petroleums were cut into 12 fractions of about 50° C. range, up to 550° C., using vacuum distillation for the higher fractions. Specific gravity, refractive index and critical solution temperatures in aniline were determined for each fraction. Aromatics were removed with 97–99% sulphuric acid and critical solution temperatures redetermined. Tables of coefficients for estimating aromatic contents from C.S.T. depressions are given, these being partly from new results by the authors, using pure compounds and SO_3-extracted aromatics. The coefficients are higher than those of Carpenter, due to the use of C.S.T. instead of aniline-point. Similar tables for estimation of naphthene-paraffin contents are given. It was found that polycyclic naphthenes had much lower C.S.Ts. for a given boiling-point than monocyclic compounds. Paraffin wax in the higher fractions was estimated by Engler-Holde's method. Unsaturated compounds were obtained by the bromine-number method, correcting for substitution. Naphthenic acids were deduced from the acid number. The oxygen compounds were usually present in very small amount, and their C.S.T. depressions were very similar to those of the corresponding aromatics. Only 1–2% unsaturateds were usually found, and these were probably due in part to decomposition during distillation.

The distillation results, specific gravity, refractive indices, C.S.Ts., bromine numbers and aromatic, naphthene, and paraffin hydrocarbon contents are tabulated for eight oils examined, together with the viscosities and molecular weights of some fractions. The petroleums examined were from Grozny (new field), Grozny (old field), Surachany, Balachany, Bibi-Eibat, Dossor, Kaluga and Perm.

The content of paraffin hydrocarbons found varies widely—up to 30% in some paraffin-base oils and reaching 50–70% in the lighter fractions, but generally becoming less with increasing boiling-point. In some petroleums the series was practically absent in the higher fractions. Kaluga oil is almost free from these hydrocarbons, being deficient in light fractions.

Naphthenes usually vary from 50–70% and form the chief constituents of most oils. The percentage normally increases in the higher fractions, although it may decrease again in the very high-boiling part of the oil. Aromatics may be present up to 30%, and occasionally to 40%.

Petroleums may be divided into six main classes, according to their composition. Paraffin-base oils contain not less than 50% paraffins in the light-fractions and about 10–15% wax in the higher fractions. Above 300°, there are more naphthenes than paraffins, these being probably monocyclic

with long side-chains. Asphaltenes and resins are almost absent, and the aromatic content is small. Example: Pennsylvanian oil.

Completely naphthenic oils are rare; 50 to 80% naphthenes are contained in some fractions. Paraffins only occur in the lightest portions, and wax only in traces. There are few aromatics, and hence little asphaltenes or resins. Example: Dossor oil.

Paraffin-naphthene base oils are common. The aromatic content is small, and the wax content almost as high as in the paraffin-base type. Examples: Grozny (paraffinic type) and Surachany.

Naphthene-paraffin-aromatic type oils are also widespread. They contain 1–2% wax and much asphaltenes and resins. Examples: Grozny (old field) and Bibi-Eibat. Balachany oil is similar, but rather richer in naphthenes than the two former oils.

The naphthene-aromatic class is also common. Paraffins are almost absent except in the light portions. Aromatics may occur up to 40%, together with considerable amounts of asphaltenes and resins. Example: Kaluga oil.

The true aromatic type, with over 50% aromatics (*e.g.*, Perm oil), is seldom found. The paraffin-aromatic type is unknown.

The separation of the individual groups is of considerable difficulty. Aromatics have been removed by SO_3 and methyl alcohol extraction, and examined, and the naphthenes have also been obtained from the naphthene-aromatic type of oil. The empirical formulae, Engler viscosities, and molecular weights, etc., have been determined for the aromatics and naphthenes in the fractions of some oils.

Up to 150° C. benzene, toluene and the xylenes are present. The 150–200° C. fraction contains cumene, butyl and amyl-benzenes, propyl-toluene, etc. The 200–250° C. aromatics are shown by their high specific gravity and refractivities to contain dicyclic aromatics; the 400–450° C. fraction contains tricyclic compounds and above 550° C. tetra-cyclic and even more complex ring structures are present. Some of the higher aromatic compounds contain also a little oxygen. Asphaltenes and resins are formed by the oxidation of these complex aromatics.

The kerosine fractions of naphthene-aromatic oils contain polycyclic naphthenes and 3- and 4-ring naphthenes occur in the higher fractions.

Only the fractions boiling above 350° C. have lubricating value. The aromatics are more viscous than naphthenes of similar boiling-point. Thus, aromatics of 400–450° C. range yield machine oils, while the naphthenes of similar viscosity have only spindle-oil viscosity. For equal boiling-points the polycyclic compounds are more viscous than compounds with fewer rings and longer side-chains. The aromatic oils have the disadvantage of being more easily oxidised.

Paraffin, naphthene, and paraffin-naphthene oils are characterised by simple ring structures and long side-chains. The paraffin-naphthene-aromatic type have more complex ring structures and shorter side-chains, while the aromatic-naphthene type are highly polycyclic. E. B. E.

551. Predicting Stability of Gasolines to Ageing. C. Winning and R. M. Thomas. *Ind. Eng. Chem.*, 1933, **25**, 511.—The apparatus used in the investigation was a modification of that used for the U.S. Army potential gum test. The bomb was of stainless steel and accommodated a test tube containing 25 ml. of the sample to be tested, the sample being assessed by means of a "breakdown" of pressure at 100° C. This breakdown was the period of time from the commencement of the test to the point at which a drop in pressure of 2 lb./sq. in. occurred. It is suggested that by employing this method in conjunction with the copper dish test, fair predictions as

regards the effects of storage may be made. It is shown that at temperatures below 100° C. the breakdown values are difficult to obtain and are of doubtful utility. W. H. T.

552. Copper Dish Method of Determining Gum Used by Majority of Refiners. G. B. Murphy and C. Wirth. *Oil & Gas J.*, 23.3.33, **31** (44), 24.—Sixteen representative refiners have been consulted in order to ascertain which of the methods for determining gum content is being most widely used for control and routine purposes. The five methods are: copper dish, oxygen bomb, air jet, steam oven, and Standard Oil Development oxygen bomb. Brief summaries of the comments of the individual refiners are appended. A table indicates the purpose for which each test is used by the refiners consulted, under the headings: (1) Routine and control work; (2) research work; (3) limited use; (4) dropped; (5) development necessary. It is seen that 13 of the refiners are using the copper dish test for routine and control work, sometimes in conjunction with other methods. For determination of preformed gum the air jet method is gaining greater favour than the steam oven method, which has been abandoned in four instances. The oxygen bomb method for potential gum is used considerably in research and development work, although a note of scepticism as to its proper interpretation and correlation is apparent. R. A. E.

553. Gum Inhibiting Index. W. W. Scheumann. *Nat. Petr. News*, 15.4.33, **25** (14), 29–32, 72.—There exists a large number of organic compounds which, when incorporated in a gasoline, have a marked effect on the tendency of the gasoline to form "gum." Some 14 of these bodies have been examined, and their efficiency in reducing gum content, together with their effect on colour, colour stability and octane value has been assessed. It is well known that the tendency of a gasoline to form "gum" increases with age, and that the rate at which "gum" is formed is accelerated after an initial "induction period" during which the "gum" formation is low and fairly constant. Gum inhibitors appear to function solely by extending this induction period. The method adopted in examining the inhibitors was that specified by the U.S. Bureau of Aeronautics for aviation gasolines. The sample is placed in an open glass bottle in a steel bomb, which is filled with oxygen at a pressure of 100 lb./sq. in., and then maintained at 212° F. for 4 hours. Gum contents were determined before and after oxydation by the A.S.T.M. Method A (D_2 1932). The Gum Inhibitor Index was then calculated as follows:—

$$\text{G.I.} = \frac{\text{Average per cent. potential gum reduction.}}{\text{Average concentration of inhibitor in mg./100 ml.}}$$

This index may be placed on an economic basis by multiplying by the price per pound of the inhibitor. The effect of the inhibitor on the colour of the treated gasoline was determined by exposing treated and untreated samples side by side in 4 oz. glass bottles, to unobstructed sunlight for 5 hours. A colour stability index is then calculated as follows:—

$$\text{C.S.I.} = \frac{\text{(Colour loss untreated sample)—(Colour loss treated sample).}}{\text{Conc. of inhibitor mg./100 ml.}}$$

A number of tables show the efficiency of various bodies in colour and gum stabilisation. It is evident that these compounds affect these factors in a marked manner, some positively and others negatively. The effect of the inhibitors on octane values is given in a final table. H. G.

554. Solubility of Ethyl Alcohol in Gasoline. O. C. Bridgeman and D. Querfield. *Ind. Eng. Chem.*, 1933, **25**, 523–526.—Solutions of ethyl alcohol of known water content in gasoline were prepared quantitatively, and the

critical solution temperature measured by observing the appearance of a second phase of cooling. This was carried out in a test-tube sealed into an air jacket fitted with a device for controlling the air pressure and the rate of cooling. Results were obtained for 23 gasolines, the critical solution temperatures being measured on blends with aqueous ethyl alcohol solutions containing approximately 99–93% of ethyl alcohol by volume. Various curves were obtained from % gasoline in the blend plotted against the critical solution temperature in ° C. It was found that at each constant percentage of gasoline in the blend the following equation was applicable :—

$$\log s = a + b/T,$$

where s is the percentage of water present and T is the critical solution temperature in absolute ° C. Numerical values for s were obtained by dividing the volume of percentage of water in alcohol solution by the volume of alcohol solution in the blend. For straight run fuels of similar volatility the source of the crude from which the gasoline is distilled appears to have comparatively small influence. Cracked gasolines may, however, show a much lower critical solution temperature than the straight-run products even of the same volatility—*e.g.*, some Pennsylvanian and Californian gasolines. Except for one or two cracked gasolines none of the gasolines investigated gave sufficiently low-critical solution temperatures to make practical the use in freezing temperatures of blended fuels containing up to 50% of alcohol unless the alcohol is almost entirely free from water.

W. S. E. C.

555. Proposed Standard Tests for Bitumen. Italian Technical Committee on Mineral Oils, Fats, etc. *Olii Min.*, 1933, **13**, 18–21, 33–34.—A brief reference is made to nomenclature, sampling and preparation of the sample for analysis. Methods are then described for the following tests : density, softening point (Ball and Ring), penetration, ductility, loss on heating (5 hours at 163° C.), a qualitative test for the present of tar, moisture, insoluble in carbon disulphide and ash.

In general the methods are similar to those usually employed. The test for tar consists in treating the alkaline extract of the sample with diazotised chlorbenzene, the development of a red colour indicating tar. A positive reaction is confirmed by the Luck Anthraquinone test, which is described in detail.

Limiting values are given for the above tests for soft, medium and hard types of bitumen.

C. C.

Class 600. Refining and Refineries.

556. Modern Pipestill Heater Design. W. L. Nelson. *Petr. Eng.*, April, 1933, **4** (7), 21.—In the first of a series of three articles on Modern Pipestill Design, the author outlines the advantages of the pipestill over the shell still, and discusses the rates of radiant and convection absorption heat, briefly referring to tube stresses and corrosion problems.

Radiation from a flame is affected by the following factors : (1) percentage of total heat in fuel absorbed as radiant heat ; (2) ratio of air to fuel ; (3) arrangement and spacing of absorbing surface, and (4) kind of fuel. The determination of the size of flame and the conditions within the flame is so difficult that it is found more useful to use empirical relationships than to attempt to evaluate the rate of radiation by the ordinary laws. The equation of Wilson, Lobo and Hottel (see *J. Ind. Eng. Chem.*, 1932, **24**, 486), for the rate of radiant heat absorption is reproduced. A table of heating values

for various refinery fuels shows that for 30% excess air, when 50,000 B.Th.U's. are liberated for each sq. ft. of projective surface, there is little difference in the rates of radiation, although gas flames gave a slightly milder rate of heating. The effect on the rate of radiation of the percentage of excess air when burning two extreme fuels—dry gas and heavy fuel oil, is shown graphically. With proper burners and experienced firemen it is always possible to fire with less than 25% excess air, although in the past many furnaces have been operated with 50 or even 100% excess air (in an attempt to maintain an absorption rate of less than 25,000 B.Th.U. per sq. ft. of projected area), because the still was originally designed with too little radiant surface. The radiating power of mixed oil and gas flames is almost as good as that of the pure oil flames. It is suggested that this is due to the radiation of the heated carbon particles to the surroundings.

For the determination of the rate of absorption of heat by convection the empirical formula of Monrad (see *Ind. Eng. Chem.*, 1932, **24**, 505) is the best available. This gives the pure convection coefficient and does not include the radiation falling on the first rows of the convection section. (The exact amount of this radiation effect will be discussed in a later article.) The effect of flue gas velocity is illustrated by a list of computed convection coefficients for a temperature of 1000° F. and a pipe diameter of 4 in. at varying velocities. Although the convection coefficient may be increased from 2·2 (at 5 ft./sec. velocity) to 8·7 by increasing the velocity to 40 ft./sec., such velocities are not practical owing to the increased height of stack necessary. 15 ft./sec. (convection coefficient 4·55) represent the optimum velocity obtainable. Factors are given for converting the convection coefficient for 4 in. pipes to those for 2, 3 or 6 in. pipes (outside diameter).

The allowable tensile strength of the tubes, even at high temperatures, is usually considerably lower than those normally used. Allowable creep tensile strengths are very low for the conditions found in a pipe still. Allowing a total deformation of less than 1% over a year's service, the allowable creep and stress for 0·19 carbon shell pipe still tubes is about 600 lb. per sq. in. Certain alloy steels, particularly the 18·8 Cr. N. steels show allowable creep stresses of more than 4000 lb. per sq. in. under the above conditions. As the creep stress varies greatly with the tube wall temperatures, it is important to know the latter factor. For a given set of radiation conditions the tube wall temperature depends almost entirely on the velocity and temperature of the fluid in the tube. For average conditions of velocity and radiation the average tube temperature is about 250° F. higher than the oil temperature. As the velocity is increased the tube temperature drops until at an oil velocity of 12 ft./sec. it is about 100° F. higher than the oil temperature. In an ordinary topping still the tube temperature is about 650° F.+250° F.=900° F., and in a cracking still 900° F.+100° F.=1000° F.

For resisting sulphide corrosion, high Cr. Steels, 18·8 Cr. Ni. steels, 8·22 Cr. Ni. steels and chromium-tungsten steels are satisfactory but expensive. For high temperature oxidation conditions with furnaces and boilers, such steels are essential, as ordinary steels fail in a few weeks. The 18·5% Cr., 7% Ni., 4% Wo steel is three times as resistant to corrosion as high Cr. steel and 0·17 carbon steel 62 times as resistant. C. L. G.

557. By-Products from Coke Oven Tar. S. P. Miller. *Chem. Trade J.*, 1933, **92**, 315.—A description is given of the development of continuous tube stills for tar distillation. In the original type, initiated twenty years ago, normal pipe still operation with fractional condensation was utilised, but it was not suitable for the production of pitches of high melting point *e.g.*, 400° F. The addition of a secondary vacuum stage drawing the hot pitch from the flash box of the first still enabled high melting pitches to

be prepared. A few years ago the Barrett Company concluded that the treatment of tar products called for designs of plant departing from the conventional, and after comprehensive research evolved the Direct Recovery Processes. One process which is in wide commercial use is based on counter current flow of hot gas against the tar. Highly superheated gas from a number of coke ovens is delivered at 1000° F./1200° F. to the distillation main or still where it is copiously showered with tar; the superheat in the gas distils the tar to pitch which overflows continuously from the still. The cooled gas which is now saturated with the highest boiling oils vapourised from the tar, and from which all entrained matter has now been removed, enters and rises through a packed chamber known as the hot gas saturator where it meets raw or preheated tar in counter current. The saturated gas passes through a short section of dry packing to remove the last traces of tar, and thence to a heat interchanger, where it gives off heat to incoming tar, and in the process cools and condenses the heaviest fractions present. The gas is then cooled, freed of distillate oils, and is diverted into the main stream of gas from the ovens not employed for distillation.

The process is strictly continuous and requires no fuel for distillation. Any tar can be treated, and any required distillates can be obtained by the use of suitable packed towers and refluxing of appropriate oils. Less decomposition and higher yields are obtained than by conventional methods.

C. L. G.

558. Plug Protector for Cracking-Still Tube Headers. F. B. Gilliams. A.P.I. Proc., Section III., Dec., 1932, 78.—This device is a corrosion-resisting metal pan formed by pressing to fit over the outside of steel plugs. It is held to the plug by rolling the edge over the top of the seat surface, and prevents corrosion of the plug and header seat. An entire plug made of 18–8 metal would have too much expansion and would be more costly. A. O.

559. Changes in Composition of By-Products during Coking in High-Temperature Ovens. S. W. Saunders and F. F. Smith. *Gas World*, 1933, **98** (2539), Coking Section, 40–43.—Determinations have been made of the hourly composition and rate of evolution of volatile matter from a Durham coking-coal when coked in a narrow high-temperature oven, 16 in. wide, average flue temperature of 1440° C. and a coking time of 14 hrs.

The results show that conditions obtaining at the third hour are such as to favour the maximum production of benzole from primary tar, whilst from the third to the eighth hour comparatively uniform yields of gas and benzole are obtained. The benzene content of the benzole, determined by the method of Jones (*J. Soc. Dyers*, 1919, p. 45), increases over this period, indicating some decomposition. After the ninth hour the benzole yield drops off considerably, but becomes richer in benzene (up to 97%), which, with increased percentages of hydrogen in the gas evolved and naphthalene in the tar, indicate the effect of increasing charge temperatures. The yield of benzole for the last two hours is negligible. W. E. J. B.

560. Refining of Petroleum by Means of Catalysts. E. Deisenhammer. *Petr. Z.*, 26.4.33, **29** (17), 3–4.—Zistersdorf petroleum, which contains only 11·4% of constituents distilling to 300° C., is distilled first with ½% of activated charcoal and then with a mixture of charcoal and silica gel in an Engler-Ubbelohde apparatus. The results show that a sample of the petroleum treated with activated charcoal gave twice the quantity of distillate to 260° C. than from the untreated sample. The benzene content increases from 1·4% (to 200° C.) to 8·1% under the influence of the activated

charcoal. No greater distillation loss is experienced with the catalyst than without and the charcoal can be used repeatedly. The silica gel does not increase the yields in products distilling to 300° C. W. S. E. C.

561. Continuous Control of the Neutralisation of Acid-treated Oils. B. S. Greensfelder. *Petr. Z.*, 29.3.33, **29** (13), 6–8.—A process is described for the continuous neutralisation of light oils which have been refined with sulphuric acid. A special apparatus is used in which the neutralisation as well as the pH value of the liquid leaving the neutraliser are determined. On leaving the neutralisation apparatus the oil is conducted under pressure upwards through a small copper tube into a combined mixing chamber and show glass. Simultaneously the indicator solution is added passing through a perforated tube and allowed to flow counter-current to the oil. By maintaining the oil-water interface in the middle of the show glass all phases are visible. The oil passes to the outlet (not as a syphon) to the upper end and the indicator solution is passed away continuously or intermittently through a valve. The velocity of flow is regulated so that the indicator solution is continuously renewed and that sufficient oil is added to enable the change in colour between the intermediate space to be noticeable in 5 or 10 minutes. The maximum velocity of the indicator solution depends on the consumption of this solution; diluted Methyl Red or Xylenol Blue is used and this is kept in a 5-gallon drum under pressure and the velocity is regulated by means of a narrow tube placed between the pressure vessel and the show glass. The show glass is calibrated to correspond with the intensities of standard solutions.

W. S. E. C.

562. Acid Sludge Removal. H. G. Vesper. *Oil & Gas J.*, 30.3.33, **31** (45) 44.—Adequate acid sludge removal is an important factor in the successful treatment of oils by sulphuric acid, but the methods at present in vogue either fail to achieve the purpose successfully or are expensive. The article deals with a new method for sludge removal when treating gasoline and kerosine, which depends on preferential wetting of the surface of a solid by one of the liquids when two immiscible liquids are simultaneously brought into contact with it. The mixture of light oil and sludge is passed through a vessel, known as a coagulator, which is partially or entirely filled with a solid non-absorbent packing material more easily wetted by sludge than by light oils. The suspended sludge is then coagulated on the packing and eventually forms drops which drain to the bottom of the shell and are withdrawn. Material of larger size is used in the bottom of the coagulator in order to separate the large bulk of the sludge, distribute the incoming mixture and support the remainder of the packing. The most suitable acid resisting packing materials found after experimental work are pea gravel and No. 4 crushed rock for use with light oils. Representative screen analyses of the main packing are given, and indicate that most of the material is retained on 4- and 10-mesh screens. Uniformity of particle size is desirable. Flow through the coagulator may be either horizontal or vertical, but the latter is preferable. Several types of commercial installations are illustrated and described. A vertical coagulator packed with 16 ft. of pea gravel or No. 4 rock will give substantially complete removal of sludge from an average gasoline at rates up to about 10 brls./hr./sq. ft. of superficial cross section, and from kerosine up to 7 brls./hr. Uniformity of flow of light oil-sludge mixture through the coagulating bed is essential, and means of attaining this object are described. Results obtained over a long period on California Straight-run stocks using a two-stage system preceded by preliminary separation in an unpacked vessel are given. Acid application vary between 10 and 50 lb. per 1000 gals. of gasoline; the acidity of the gasoline from the first coagulator averages 0·61, and from the

second, 0·21 lb. H_2SO_4 per 1000 gals. The results also show that up to the limit of capacity neither increased throughput rate nor variation in acid-treating rate appreciably affects final acidity, but 15% fuming acid gives higher acidities than recovered acid of 87/95% strength. An acidity reduction of over 90% is thus achieved, which means removal of practically all sludge, the balance being due to dissolved SO_3 and acid reaction products. The stock leaving the system is bright in appearance and is ordinarily neutralised with soda. Dry neutralisation may also be satisfactorily employed.

Advantages claimed for the system are: (1) Elimination of water washing of acid gasoline containing sludge, resulting in economy of chemicals for equal colour stability; (2) elimination of corrosion due to acid water; (3) removal of tendency to emulsification during neutralisation; (4) facilitation of acid recovery due to more complete removal of oil. The process operates continuously and requires little supervision or maintenance. Installation costs and savings due to reduced chemical usage are discussed. The installations described are protected by issued patents and pending application. R. A. E.

563. Dichlorethyl Ether Used as a Selective Solvent in Lube Manufacture. J. M. Page, C. C. Buchler and S. H. Diggs. *Nat. Petr. News*, 5.4.33, **25** (14), 35–44.—Selective solvents used in the extraction of lubricating oil with a high viscosity index fall into two classes: (1) Those miscible in all proportions with low viscosity index oil but which nevertheless dissolve substantial quantities of high V.I. oil; and (2) those in which high V.I. oil is nearly insoluble, but in which low V.I. oils are not miscible in all proportions. $\beta\beta'$ dichlorethyl ether is a solvent in which it is claimed high V.I. oil is insoluble, but that it is miscible in all proportions with low V.I. oils. Graphs and tables substantiate this claim. A table giving the physical properties of "Chlorex," as the solvent is called, shows that it has the desirable features of high boiling point, low freezing point, high gravity, low viscosity, low vapour pressure and a satisfactorily high flash point. It is non-inflammable at ordinary temperatures. Extraction may be carried out by any of the usual methods, and a table shows the relative efficiencies of three methods, viz.: (*a*) Single batch; (*b*) multiple batch, and (*c*) 3-stage counter current; and it would appear that 250% vol. solvent is more efficient when used in method (*c*) than 600% vol. used in method (*a*). A flow sheet is given for a plant operating on the 3-stage counter current process. Tables showing the properties of various oils before and after extraction indicate that "Chlorex" is efficient in increasing the viscosity index and reducing the Conradson carbon residue and sludging time. It is claimed that the solvent is satisfactorily non-toxic and non-corrosive, though in the latter connection it is necessary to neutralise the small quantities of HCl formed by decomposition during recovery. Decomposition and chemical reactivity during extraction appear to be satisfactorily low since chlorides, calculated as HCl, are less than 0·002% wt. in the raffinate, and less than 0·010% wt. in the extract. Chlorides have not been detected in raffinates subjected to a final clay treatment. Loss of solvent during use is claimed to be less than 0·2% per cycle. H. G.

564. Use of Phenol as a Selective Solvent in Refining Lubricating Oils. R. K. Stratford, H. H. Moor, O. S. Pokorny. *Nat. Petr. News*, 29.3.33, **25** (13), 17–24.—The extraction of the undesirable constituents of lubricating oil by washing with absolute phenol is discussed. In the plant described, Columbian flash coil distillate at 100–120° F. is passed counter-stream to anhydrous phenol, at the same temperature, through a washing plant consisting of 7

"Leaver" mixers. The treated oil from the last settler contains 8–15% phenol, and is pumped to a recovery unit incorporating a pipe still and a 14-plate bubble tower operating under atmospheric pressure. The spent phenol, containing 25–30% oil, is passed to a recovery unit yielding pure phenol and the extract. The treated oil contains 0·005% phenol and the extract 0·07% phenol. The amount of the phenol used is from 125 to 165% wt. on the weight of the charge. In this way, it is claimed, a range of lubricants which includes turbine and transformer oils of exceptionally high quality, and an aero engine oil which meets the British Air Ministry specification is obtained. Many advantages are claimed for the process: (1) The action of phenol is purely physical, no decomposition occurs; (2) processing is at the relatively low, and therefore economical, temperature of 100–125° F.; (3) the density and solubility of phenol are such that settling is rapid; (4) the recovery of the phenol is complete and simple; (5) phenol treatment eliminates or reduces the need for acid finishing and reduces the amount of clay used for contacting; (6) under normal conditions phenol is non-corrosive to refinery equipment, is non-toxic and less dangerous to handle than sulphuric acid. The extract is unsuitable for use as a lubricant, but it has been used as cracking stock in the production of a high octane number gasoline and in the preparation of a number of special products such as asphalt. H. G.

565. Carburetting Stabiliser Residue. A. I. Sellers. *Oil & Gas J.*, 23.3.33, **31** (44), 12.—In the past, stabiliser residue, consisting of propane and butane, has either been used as boiler and plant fuel or burned as waste. With the demand for gasoline of lower V.P. the amount of waste is tending to increase, and many plants are unable to dispose of the excess except by wastefully burning. One company is extracting gasoline with plant of the compression type from a gas with high gasoline content. The residue is insufficient to meet plant and field fuel requirements, and contains too much air to give good results as an engine fuel. As the price of fuel gas is high in that district, it was decided to manufacture products of lower V.P. from the stabiliser and use the lighter gasoline for enriching and carburetting to a suitable engine fuel when mixed with the residue from the natural gasoline plant. The excess butane is collected in the reflux accumulator and revaporized by waste heat. Air for carburetting is supplied by a compressor, and is discharged through a cooling coil at 50 lb. pressure to remove moisture before mixing with the gas. The method used for mixing the air and gas and the various safety devices installed are described. R. A. E.

566. Stabilisers. E. G. Ragatz. *Petr. World* (L. A.), 1933, March, 38–43.—Of the various questions recently submitted to the California Natural Gasoline Association on the subject of stabilisers, eight representative ones which appear to cover the subject more or less broadly are selected by the author and shortly answered. The selected questions were: (1) How should reflux ratio be defined, what is its significance, and should the quantity of bottoms be considered as well as the quantity of overhead in setting reflux ratio? (2) What is fugacity and what is the effect of column pressure on column efficiency? (3) Why is it sometimes impossible to lower the top temperature of the column regardless of the amount of reflux used, bottom temperature and column pressure remaining constant? (4) Is there any way to compensate for too few trays and would supercooling of the reflux be of any advantage? (5) What effect has feed temperature on the column temperature gradient, what is the optimum value and where should the feed, including any high stage condensate, be introduced into the column? (6) How is a column designed for a given capacity? (7) What are the approved methods of control for a simple stabiliser producing a fixed vapour-pressure bottoms

and should any attempt be made to control the overhead temperature? (8) How close a bottoms vapour-pressure control can be maintained by a modern column? Graphs are given of the effect on column temperature gradient obtained by varying the feed temperature in stabilising pressure distillate, of tray temperature gradients, and of liquid and vapour tray loads calculated for a given set of operating conditions. G. R. N.

567. Gasoline from Cottonseed Oil. G. Egloff and J. C. Morrell. U.O.P. Pamphlet No. 119 (Paper presented before A.C.S., April, 1932).—The cracking of cottonseed oil is not at present of economic importance, but the behaviour of fatty oils under cracking conditions is of some interest. In the case of national emergency such oils might be of importance, and in countries such as Turkey or Egypt, where large supplies of cottonseed oil are available and the price of gasoline is high, cracking might be worth consideration.

Experimental cracking tests by the non-residuum method were carried out at a pressure of 135 lb./sq. in. and over a temperature range of 445° C. to 485° C. The cottonseed oil had the following properties: sp. gr. 0·923; saponification value, 159; acid value, 2·0; water, 0·3%; I.B.Pt. 237° C.; 9% to 300° C.; E.Pt. 371° C. Cracking gave the following yields: pressure distillate, 71·1%; water, 5·3%; coke, gas and loss, 23·6% (coke 40 lb. per brl.; gas, 916 cu. ft. per brl. of charge).

The pressure distillate had sp. gr. of 0·772 and a saponification value of 40 and acid value of 33, indicating that the glycerides had been decomposed into hydrocarbons and acids of relatively low molecular weight. After treatment with acid, water washing and neutralisation with soda, it was distilled to give about 70% motor fuel of the following properties (after refining by refluxing with strong NaOH to remove esters and fatty acids): sp. gr. 0·761; colour, Saybolt 30+; Doctor, Sweet; corrosion, negative; sulphur, 0·01%; gum, 33 mg. per 100 ml.; I.B.Pt., 40° C.; 5% to 63° C.; 10% to 75° C.; 20% to 89° C.; 50% to 128° C.; 90% to 187° C.; E.Pt. 204° C.; octane number, 55. The composition of the gasoline is given as: paraffins, 37·1%; unsaturateds, 27·1%; naphthenes, 9·9%; aromatics, 25·9%.

The pressure distillate bottoms were suitable for use as Diesel or gas oil or could be further cracked, and had the following properties: sp. gr. 0·912; I.B.Pt. 228° C.; 80% to 300° C.

The coke was of a firm honey-comb structure and deep black in colour. The calorific value was 15,600 B.Th.U. per lb., and the analysis: moisture, 0·16%; volatiles, 8·48%; fixed carbon, 90·16%; ash, 1·20%.

The combined Burrell and Podbielniak analyses of the cracked gases are shown, and brief reference made to the presence of acids and aldehydes in the water produced in the cracking reaction. C. L. G.

568. Effect of Acid Treatment on Octane Values of Cracked Gasolines. S. Born. *Nat. Petr. News*, 5.4.33, **25** (14), 23–28.—The available information on the effect of the treatment of cracked distillates with regard to colour, colour stability, sulphur content and gum formation is reviewed at some length. A description is given of work undertaken to investigate the effect of acid treatment of cracked distillates. The cracked distillates used for the work were from three different sources, and represented distinct types of commercial cracking practice. Two litres of the distillate were agitated by shaking in a glass bottle for five minutes, with the required amount of sulphuric acid. After agitation, the distillate was allowed to settle, was decanted from the acid sludge, neutralised with 12° Bé. caustic soda, water washed, settled and redistilled in a still of special design, a diagram of which is given. In this way the effect of acid concentration, the amount of acid

used, and settling time before decantation from the acid sludge were determined. These factors are correlated in tables and diagrams, with the colour, gum content, sulphur content and octane values of the refined gasolines. The last-named determinations were carried out on a series 30 B. ethyl engine, using a jacket temperature of 212° F. and spark advance of 15° and standard reference fuels A. and B. The conclusions drawn are that acid treatment can be successfully applied to almost any type of pressure distillate under the proper conditions of time, temperature and acid concentration to give gasolines of good colour and colour stability, low gum content, and with very little loss in octane value. H. G.

569. Desulphurisation of Gasoline. C. W. Wagner. *Oil & Gas J.*, 30.3.33, **31** (45), 38.—A brief history of the methods which have been adopted for the removal of mercaptans, hydrogen sulphide, etc., from gasoline is given. A description is given of a continuous method by which these products may be satisfactorily removed from the average gasoline without great expense. Raw gasoline and spent caustic soda, containing at least 3/4% of sodium sulphide, are fed into a mixer by means of a pump in the proportions of approx. 5 : 1. From the mixer, the mixture of gasoline and spent soda solution enters four successive settling tanks at a point near the bottom and leaves in an overhead stream. The spent caustic soda solution is drawn off from the bottom of the settling tanks and fed to the pump. The overhead line from the last settling tank leads to a second pump which charges the gasoline and fresh caustic soda solution into a mixer, and the same procedure is followed as in the case of treatment with spent soda solution. In the first stage most of the H_2S is removed by the soda, thus increasing the concentration of sodium sulphide, which in turn absorbs the free sulphur dissolved in the gasoline, forming sodium polysulphide. Part or all of the mercaptans (depending on nature and concentration) are oxidised to disulphides by the sodium polysulphide. The fresh soda solution (15/20° Bé) removes traces of H_2S and sodium hydrogen sulphide carried over from the first operation. By the time the first solution has lost its effectiveness, the second has absorbed enough H_2S to replace it. Where repressuring of oil sands is being carried out, difficulty is sometimes encountered due to oxidation of H_2S in the natural gasoline recovery systems. Free sulphur occurs in considerable quantity in the recovered gasoline, and is not removed by caustic washing. Hypochlorite treatment is liable to give an off-colour corrosive gasoline on account of hydrolysis of sulphur chloride, formed in treatment, by light or contact with rust. The method described is frequently sufficient not only to remove free sulphur, but to effect complete sweetening as well. Efficient mixing of gasoline and caustic solutions may be achieved by means of a series of orifice plates. The diameter of each spool should be not less than 3 x diameter of orifice, the length not less than $2\frac{1}{2}$ x the diameter. 6/8 spools are required in the mixer. A pressure drop of 5 lb. per orifice plate is required in this type of mixer. The diameter of orifice to use may be calculated from the formula $Q\sqrt{N} = 37{\cdot}998cA\sqrt{P/D}$, where Q = U.S. gals. per min., N = No. of plates, c = constant (0·65), A = area of orifice in sq. in., P = total pressure drop in lb. per sq. in. through mixer, D = density of liquid. R. A. E.

570. Gum Formation in Gasoline: II. Control of Gum Formation in Gasoline by Anti-oxidants. T. H. Rogers and V. Voorhees. *Ind. Eng. Chem.*, 1933, **25**, 520.—The efficiencies of a number of compounds intended for preventing gum formation have been assessed by the Voorhees method, and it has been found that the increase in induction period is directly proportional to the concentration of anti-oxidant. Readily oxidisable compounds are the most effective inhibitors, amongst which the mono substituted *p*-amino

phenols are of outstanding value. In particular, *p*-benzyl amino phenol has marked advantages over materials such as α-naphthol and the polyphenols, being more than twice as soluble in gasoline as in water and also colour stable. The effectiveness of this inhibitor in stabilising gasolines in barrel storage has been confirmed. W. H. T.

571. **Dyes and Dyed Gasolines.** R. G. Clarkson. *Oil & Gas J.*, 30.3.33, **31** (45), 50.—In commercial practice 2/15 parts of dye per million parts of gasoline are used. In spite of the small amounts used, the solubility of the dyes must be fairly high in order to resist any change in colour by storage conditions, such as contact with water or exposure to low temperature. The number of satisfactory dyes is limited, because most are water-soluble, and therefore not oil-soluble, and also because many are not stable to light when in solution in the gasoline. The quality of gasoline has an important bearing on the second factor, fading being more rapid in cracked than in straight-run gasoline. The fatty acid salts of basic dyes—*e.g.*, oleate of malachite green, which were among the earliest types of colour used in gasoline—are now of little value owing to the rapidity with which they fade in solution in cracked gasolines. Dyes which are principally used now are the azo dyes and anthraquinone derivatives. The former are less expensive to manufacture. Most of the red and yellow dyes used belong to the azo group—*e.g.*, Du Pont oil yellow, oil orange and oil red. The methods of preparation are outlined. Some oil-orange dyes are mixtures of oil red and oil yellow dyes. The mixtures offer the advantage that gasoline of varying initial colour can be given a uniform appearance by varying the proportions of red and yellow, but unless great care is used in selecting dyestuffs of equal light fastness and sensitiveness to gasoline, the dyed product may change in shade during storage A large number of oil-soluble blue, green and violet azo dyes are known, but none of them possess satisfactory fastness to light in cracked gasolines. For these shades it is therefore necessary to use anthraquinone derivatives. The most widely used gasoline blue is 1 : 4 ditoluido-anthraquinone. Violet shades are produced either with pure anthraquinone compounds or by the use of an anthraquinone blue shade with an azo red, the former method being more satisfactory. Purple shades are generally obtained by shading a violet or reddish blue anthraquinone dye with an azo red. No satisfactory pure compound green dyes are known, and this colour must be obtained by mixing a greenish anthraquinone blue with an azo yellow. It is often found that although the blue alone is faster than the yellow, the mixture will fade to an extremely yellowish green. This phenomenon is connected with the composition of the gasoline, but not with the degree of unsaturation, and is so far inexplicable. The green shades obtained by mixing are generally dull and more of an olive shade than an emerald, owing to the reddish cast present in nearly all the yellow dyes on the market. The present state of the art of colouring gasoline therefore offers opportunities for important developments.

R. A. E.

572. **Improvement of Spray Oils.** J. H. Green. *Oil & Gas J.*, 2.2.33, **31** (37), 8.—An investigation has been carried out of various methods of treating petroleum oils used in plant sprays in order to reduce injury to growing plants.

Injury to plants has been attributed to unsaturated sulphur, oxygen or nitrogen compounds, but the effect of the last named must be very small. Sulphonated oxidation products have been shown to be efficient insecticides, but their innocuousness towards plants has not yet been proved.

Tests were carried out on barley seedlings (which have previously been

shown to behave similarly in injury tests to apple leaves), the oil being applied to both sides of the seedling with a camel hair brush. After three days they were cut and weighed, the tests being carried out in batches of 10 to minimise error. A wide variety of spray oils, varying from completely sulphonated to dark poorly refined oils with sulphonated residue of 25% or more were examined.

It was found that the injurious compounds were not concentrated by distillation, but rather that the heat of distillation tended to increase the amount of sulphonatable material. No improvement was effected by treatment with HNO_3, Cl_2, K_2MnO_4, $CuSO_4$ and copper oxides and lead, the first named having definitely harmful results. It was found that filtration decreased the injury to the seedlings, and an attempt was made without success to accomplish the same result more efficiently by electrical precipitation. Filtration through various media, fuller's earth, acid treated earth, mixture of fuller's earth and activated charcoal, ignited fuller's earth, commercial fuller's earth, hydrated silica and volcanic ash, showed varying degrees of injury reduction. Volcanic ash treated oil was only slightly improved, owing to the rapid filtration reducing the degree of adsorption. Hydrated silica also unaccountably failed to show much improvement. Extraction of the oil with gasoline followed by distillation showed an improvement but not to the extent of the filtered oil. Edeleanu treatment effects improvement similar to that of filtering, while oxidation had little effect unless followed by filtration. Sulphonation followed by three or four filterings gave very good results, while sulphonated and nitrated oils gave bad results. Steam distillation gave oils with a bad injury effect, and an alcohol extracted oil very good results. Extraction with acetone, formaldehyde or ammonia gave no significant results.

The conclusion is reached that the substances in spray oils which cause injury to plants can be partially removed by filtration, sulphonation or alcoholic extraction. C. L. G.

573. Fire Protection in Refineries. *A.P.I. Division of Refining Booklet.* First Edition, 1933.—A comprehensive survey is made of the whole question of fire protection in petroleum refineries. The lay-out of refineries with a view to preventing fires is discussed, and typical examples of fire protection design are given. All types of fire-fighting appliances are described and appropriate complete equipments suggested. Data for the calculation of fire foam and pumping installations are given, together with the procedure to be adopted in combating an outbreak. H. G.

574. Knowles Coking Process. A. L. Foster. *Nat. Petr. News*, 8.3.33, **25** (10), 26–34.—The plant described is a commercial unit operating on heavy refinery residuum to produce a hard, dense coke together with gas oil, low viscosity fuel oil and gasoline. The disadvantage of the shell type of coking still is said to be a failure to produce a coke hard enough to withstand transporting without crushing, and the necessity for the frequent replacement of still bottoms owing to the severe local overheating necessary. The plant consists of a double battery of 6 ovens each with a tubular preheater, charging pumps, vapour draw off and condensing system, a ram for removing the hot coke and a quenching and grading plant.

The preheater is a conventional pipe unit and the charging stock is circulated at a maximum rate to minimise coking in the preheater. The ovens, which are 30 ft. x 10 ft. with a sprung arch 5 ft. high at the centre, have floors of refractory tiles, and are set on a reinforced concrete base which is well insulated from the oven proper and air cooled. The entire heated

portion of the oven, the flues and vapour draw-off main are lined with fire-clay tiles. The oven doors are of steel, lined with fire clay. They are fitted with suitable sealing and clamping devices, and may be raised for emptying the oven of coke. Two rows of 10 burners each below the oven floor level supply heat. The charging stock is sprayed on to the oven floor from a splash plate of alloy steel, for 2½ hours, while the oven temperature is maintained at 850° F. The supply is then stopped and the temperature is raised to 1050° F. during 1–2 hours to dry the coke. The door is then raised and the coke removed by a mechanical ram. The coke is discharged into a truck and quenched with water, crushed to a suitable grading and screened. A typical yield from 100 gal. of charge is given as gas oil, 25·7%; fuel oil bottoms, 46·1%; gasoline, 3·39%; gas (800 B.Th.U./M. cu. ft.), 1575 cu. ft.; coke, 165 lb. The coke is stated to be 96–99% fixed carbon, and to have a calorific value of 14,500 B.Th.U./lb. Operating, labour and replacement costs are said to be satisfactorily low. H. G.

575. Estimating Refinery Construction Costs. Part III. Surveying and Road Building. G. W. Heinecke. *Petr. Eng.*, April, 1933, **4** (7), 56.—The present article discusses surveying, building roadways, maintenance of plant site during building operations, final clean up of plant site and removal of trash and excess earth.

Surveying estimates, including staking the location of the plant site, and of the various pieces of equipment, pipe trenches, establishment of grades, etc., consist entirely in the salaries of the surveying staff.

The estimate for the cost of road construction should include: (1) Clearing and grubbing. This ranges from $.40 to $.175 per acre, depending on the type of surface to be cleared. A tractor and winch should be used to reduce the cost. (2) Excavation. For light soils this is about 18/20 cents, ranging to $0.50/$.1.00 per cu. yd. for solid rock excavations. (3) Cost of road. The selection of the most suitable type of road will depend on the nature of the soil and source of supplies of aggregate, climatic conditions, drainage available and permanency required. The average cost of building the different types of roads—*e.g.*, dirt, clay-sand, gravel crushed rock and concrete, with (1) no surfacing and (2) surfacing consisting of road oil, double asphalt, triple asphalt or 2 in. asphaltic concrete, is tabulated, and the advantages and disadvantages of each type of road discussed in detail.

The prices of corrugated steel culverts of 16 gauge is quoted and reference made to the availability of reinforced concrete culvert pipes.

The estimate for the maintenance of plant site depends on soil conditions, type of roads, weather, etc. If road and weather conditions are good, this should be nominal.

A nominal sum will also usually suffice for the cost of removal of trash and excess earth from the site.

With the information given, little difficulty should be experienced in developing a satisfactory estimate of the cost of preparing the plant site.
C. L. G.

576. Metallurgy of Refining Equipment. R. L. Duff. *Refiner*, 1933, **12**, 110–114.—In addition to the ordinary properties demanded by temperature limits of 1800° F. to 100° below zero and pressure requirements varying from vacuum up to 5000 lb. per sq. in., other factors such as corrosion, temperature scaling, thermal expansion, thermal conductivity, machinability and stability under service conditions require consideration in selecting metals for specific services.

The installation of samples, conveniently of size 6 x 3 x ¼ in. under working conditions is preferable to laboratory corrosion tests, in which

conditions are often too favourable where in addition to anti-corrosion properties, strength, stability and temperature scaling resistance is required, other tests have to be applied.

Short time elevated temperature tests yield an indication of strength but omit the time variable, which is incorporated in the "Determination of Limiting Creep Stress," a test taking six months to a year to run but yielding reliable stresses for design purposes.

Stability is tested by means of a standard impact machine, such as the Charpy, in conjunction with an electric furnace, in which bars of the metal under test are heated for varying periods up to one year at the maximum temperature at which it would be subjected to in service. Using the impact machine samples are broken at this temperature and duplicates are allowed to cool and broken at room temperature. Differences obtained between the values before and after heating indicate the stability.

Temperature scaling tendencies can be determined either by test pieces installed in a combustion chamber or by observation of equipment in service.

A variety of metals and alloys are utilised in refinery construction. Cracking furnace tubes require low carbon, 18% chromium, 8% nickel for the radiant section, and in the convection section both plain carbon and 4/6% chromium plus ·4–·6% molybdenum. For preheater tubes the stock and temperature determine whether the tubes should be plain carbon or 4/6% chromium with molybdenum. Stock run, temperature and pressure decide the material for heat exchanger tubes, which may be made of Admiralty metal, 4/6% chromium plus molybdenum or 18% chromium, 8% nickel. Tube sheets and headers should be of the same material as the tubes.

The cooling liquid, temperature and pressure of the vapour are considered for choice of condenser pipe material, usually extra heavy steel pipe or cast iron, but discarded 18% chromium, 8% nickel tubes, if available are preferable, especially in the upper turns of condenser pipe, where accelerated corrosion occurs. Return headers are usually made from carbon steel, low chromium nickel of 4 to 6% chromium plus molybdenum. Flanges for piping are usually made from steel or a low chromium-vanadium steel. Bolts for temperature below 500° F. and 300 lb. pressure may be of common steel; under more drastic conditions, of chrome nickel, chrome vanadium and other alloy steels.

Tube hangers and supports require to have a marked resistance to scaling and high chromium nickel alloy is used.

Fractionating column shells are constructed of common steel, but bubble caps from cast iron, although some fractionating trays are fabricated in steel, whilst the material of pressure vessels, valves and pumps depends on the service demanded of them.

A low carbon content should be specified in all chrome and chrome nickel alloys, not exceeding 0·07%, as carbides gradually migrate to the crystal boundaries and also the low carbon content tends to prevent air hardening in straight chrome steels. Most straight chromium steels are air hardening at temperatures above 900° F. over long periods, but resistance increases with the percentage of chromium. A steel containing 12 to 14% chromium is corrosion and abrasive resistant. Corrosion resistance is improved by polishing.

Eighteen per cent. chromium, 8% nickel type steels present a basic structure different from straight chromium alloys, possessing great toughness and being non-magnetic and ductile. As the percentages are increased up to 30%, strength, corrosion and oxidation resistance are increased.

Despite statements to the contrary, chrome alloys cannot be safely gas-welded or brazed. B. C. A.

577. Meeting Problems of the Pressure Vessel User. (Pt. I.) J. McL. Jasper, O. E. Andrews and L. J. Larson. *Refiner*, 1933, **12**, 115–121.—The use of arc welding has rendered possible the economical fabrication of large vessels for use at high pressures and temperatures. Single vessels up to 700,000 lb. weight, operating between 900 and 1000° F., have been in service for four years. Others of welded alloy steel have operated at 5000 lb., but at lower temperatures.

Welding renders overlapping of joints unnecessary, and the application of improved joints and shapes made possible by welding requires that all openings be reinforced to bring up the structural strength in a balanced manner, which reinforcement can be better supplied by welding than by any other means.

The general requirement for an economic material is least cost of the resulting equipment per unit for a given quality of product as regards safety, resistance to high or low temperatures and corrosion. Load-carrying materials include carbon and minor alloy steels. The highly corrosion-resistant steels are expensive and therefore of limited application as load-carrying materials. Where thickness is required for vessels subject to corrosion, carbon steel may be used for load carrying with a spot-welded alloy liner as a protection against corrosion. Service tests on refinery equipment have shown no apparent attack on corrosion-resistant liners after five to six years' service.

The processes available for the construction of pressure vessels are: riveting, bolting, forging, hammer or forge welding, resistance welding and autogenous welding. Of the types of the last named, the metallic arc process using a properly coated electrode is the most flexible in producing a reliable joint, and may be applied to carbon and alloy steels.

Carbon steels can be welded in thickness as great as has yet been required, the properties of the weld metal being adjusted so that the strength of the weld is greater than that of the plate, ductility slightly less and a higher resistance to service corrosion. The welds for low alloy steels, as sometimes used for pressure vessel construction, behave similarly to carbon steel welds.

For high pressure service, the load-bearing steels are protected with a line of stainless metal of chrome or chrome-nickel steel, attached by electric spot-welding. Recent developments have rendered possible the welding of 18% chrome steel with the retention of the ductility and corrosion resistant properties in the weld, equivalent to that of the plate material.

A table is given showing yield point, ultimate strength, and elongation of steel and weld for carbon, manganese, nickel, crome vanadium, chrome and chrome nickel steels. B. C. A.

578. Alloy Steel Tubes for Refinery Service. H. D. Newell. *Refiner*, 1933, **12**, 122–131.—A considerable success is now attending the use of alloy steels by reason of increased knowledge and care on the part of both user and manufacturer. Alloys containing over about 16% of chromium in the absence of nickel are satisfactory as regards corrosion resistance under severe operating conditions, but are unsuitable by reason of developed brittleness on cooling.

Nearest to plain steel in composition, properties and costs is carbon-molybdenum steel, which possesses a higher strength at elevated temperatures. Superiority in corrosion or oxidation resistance remains to be determined from installations now in service.

The use of alloy steels containing 4 to 6% of chromium is expanding. These are fairly resistant against corrosion, 4 to 10 times the resistance of carbon steel, and have a superior elevated temperature strength and resistance to

oxidation. They are not, however, "stainless." Such steels are characterised by air hardening, which is proportional to both carbon and chromium content when cooled from above temperatures of 1500° F. Careful annealing is necessary after hot working, forging, Vanstoning or welding. The addition of tungsten (0·75–1·25%) increases the creep strength but fails to correct the cold, brittle character of the alloy. Coldbrittleness results from the slow cooling of the metal from elevated operating temperatures, and manifests itself increasingly as temperatures decrease from 200° F. to 70° F. or below. It is therefore good practice to clean or reroll plain chromium or tungsten tubes at above 200° F.

The addition of molybdenum (0·40–·65%) to 4 to 6% chromium steel improves the high temperature creep strength, eliminates temperature brittleness, providing heat treatment has been properly done, and enhances resistance to corrosion.

Stainless 18% chromium 8% nickel alloys, although highly resistant under extreme temperature pressure conditions and to crudes, have not been adopted because the conditions usually do not justify their use and cost. In most cases the use of tubes of this alloy is restricted to the furnace radiant section. Their use in heater exchanger and condenser tube installations has not been altogether successful, cracking through fatigue, due to insufficient freedom for expansion, having occurred, which fatigue is accentuated by cooling water corrosion. Fatigue cracking alone has been eliminated by the substitution of a stainless alloy, having a lower coefficient of expansion than the 18–8 alloy.

The retardation and prevention of the grain boundary carbide precipitation associated with austenitic 18–8 alloys is under investigation. The addition of titanium has been of some advantage, but insoluble titanium compounds remain distributed throughout the metal, resulting in lessened resistance to general corrosion and greater difficulty of fabrication. The grain refining action of titanium may be secured by other means (patent applied for), and the fine grained structure obtained is permanent under service conditions.

The effect of stress and high temperature over long periods is expressed as creep rates or values, usually in terms of 1% elongation in 10,000 or 100,000 hours, plotting creep stress against temperature. The permissible extension and the probable life of the equipment based on safety factors, corrosion rates, obsolescence, etc., then govern the stress value selected. Such tests demonstrate the beneficial effect of the incorporation of molybdenum in a chromium and plain carbon steels. Tables are given showing the composition, typical physical properties and creep stress data for cracking coil tube materials. B. C. A.

579. Alloy Steels in Refinery Construction. F. N. Speller, *Refiner*, 1933, **12**, 132–139.—The principal types of corrosion in refinery equipment may be classified according to temperature ranges into firstly, at temperatures below 400° F., the dissociation of chlorides in stills and action of brackish water in condensers, accelerated by the presence of hydrogen sulphide and by other sulphur compounds produced by, associated with, purification operations; secondly, at temperatures above 400° F., decomposition of sulphur compounds in the crude; and thirdly, high temperature oxidation by furnace gases.

Corrosion protection is based on protective film formation, the efficacy of which varies mainly with the nature and concentration of attacking elements and temperature. The metals that may be alloyed with iron to form these protective films at reasonable cost include chromium, nickel, silicon, molybdenum and aluminium.

In developing corrosion resistant metals the physical qualities have also to be considered, and the selection of metals for high temperatures, etc., is

usually a compromise based on a consideration of minimum physical properties under service, environment, fabrication, corrosion-resistance, abrasion-resistance and relative cost.

The demand for steel for service above 900° F. has necessitated the study of the changes that occur in steels at elevated temperatures. The 18–8 type of ferrous alloys, having a relatively high creep value combined with resistance against corrosion, fulfils commercial requirements of certain high-temperature service better than any other metal now available. The cause of inter-granular corrosion occasionally found in this alloy is now fairly well understood, and two modifications of 18–8 are available, which may render this alloy suitable for service up to 1400°F.

A bibliography of thirteen references is appended. B. C. A.

580. Alloys Steels for Petroleum Refining Equipment. Anon. *Refiner*, 1933, **12**, 140–147.—The first alloy believed to be used for cracking coil tubes was the 16·5/18·5 straight chrome low carbon alloy. The embrittlement after exposure to 900–1025° F. resulted in its withdrawal from such service, to be succeeded by 18–8 type alloy which was free from embrittlement and possessed better creep strength. This, in a limited number of cases, led to tube failure, without initial bulge warning, due to excessive temperature-pressure conditions, now recognised and avoidable.

The increase in cost of this alloy over carbon steel and the occurrence of conditions fatal to carbon steel, but yet not severe enough to warrant the use of 18–8, led to the introduction of 4–6% chromium alloy. The embrittlement of this alloy was overcome by the addition of small quantities of molybdenum and/or tungsten. It is reported to give 4 to 10 times the life of carbon steel at several times the cost. As an example of application, an Eastern refiner is said to have installed 18–8 in the hottest zones, then 4–6 chromium, with molybdenum and carbon steel tubes, in the coldest zones of the cracking furnace.

Alloy tubing should be fitted with return bends of the same material. High-content chromium and nickel alloys are used for tube supports, tube sheets, and other heat-resistant furnace parts. Chambers may be lined with 18–8 material, attached by spot-welding.

The manufacture of alloy steels, operation of piercing mills, and fabrication, including purging and flanging, rolling, drawing, welding, annealing and pickling are described. B. C. A.

581. Metal Spraying in the Petroleum and Natural Gas Industries. H. B. Rice. *Refiner*, 1933, **12**, 148–152.—Metal spraying consists of melting commercial metals and simultaneously atomising and impacting the molten particles against surfaces to form continuous, adhesive and cohesive layers of the metal sprayed. Metal in the form of wire is fed automatically into a oxy-acetylene flame and a strong air blast atomises the molten metal, propelling it from the nozzle. The power to move the wire into the flame is supplied by an air turbine, and any commercial metal of standard size may be used.

Surfaces to be coated must be free from oil or moisture and must be roughened. Roughening may be effected by sand or steel grit blasting, but often mechanical roughening with air or lathe tools is used in addition. The molten particles solidify on impact, and as the metal spray is moved similarly to a paint spray, very little heat is transferred to the object, and no heat distortion need occur.

A large test application of molten zinc to gas-holders to resist atmospheric corrosion cost 20 cents per square foot, as compared with 10 for paint, which under the conditions prevailing begins to fail after five years. At other

locations, particularly in maritime districts, where similar paint lasts less than two years, such units will be entirely sprayed with zinc.

Zinc and aluminium can be sprayed at about the same cost per unit volume, and 0·005 in. thickness suffices for protection against atmospheric corrosion.

Other anti-corrosive applications of metal spraying are: Exposed surfaces of gas and oil burners to reduce heat corrosion, replacement of worn or corroded areas of machine parts, interior surfaces of pumps for handling acid oil, acid, corrosive gasoline, etc., and for the interior of reaction chambers. In the last instance completely satisfactory results were not obtained, but a 100% protection over six months is anticipated for the future at a cost of less than $1000 per annum. The metals sprayed are chosen for the specific requirement, and include stainless steel, monel, bronze, aluminium, cold rolled steel, Norway iron, and high carbon steel, all from ⅛ in. diameter wire.

B. C. A.

582. Rapid Method of Evaluating Corrosion. C. M. Chapman. *Refiner*, 1933, **12**, 153–155.—The exposure and examination of test specimens inserted in closed vessels under operating conditions may be facilitated by the use of a corrosion tester, which represents a means of introducing and withdrawing specimens without interruption to plant operation. Specimens are attached to the end of a threaded spindle by means of which they are projected through a valve and connection into the vessel for exposure, and withdrawn for inspection by removal of the projecting spindle and yoke attachment from the valve. The exact type and size of the inserted specimens is limited by the diameter of the passage way through the valve and connection (14/16 in.) and to a length which allows clearance with the valve gate, about 1½ in.

A quick method for determining the relative suitability of metals for corrosion resistance consists of polishing one or more exposure surfaces of a test specimen to such a degree as to permit microscopic observation of corrosion. As a highly polished surface tends to inhibit corrosion, the final polish is made with No. 4/0 emery paper, which finish does not inhibit corrosion. In actual tests specimens thus prepared were exposed to the action of corrosive water for 16 hours, and the specimens, by microscopic observation, subsequently arranged in the order of resistance, which approximated to the valuation obtained by two-year service tests. B. C. A.

583. Alloy for Corrosive Service. W. L. Cockrell. *Refiner*, 1933, **12**, 156–159.—Developed originally by Prof. S. W. Parr, of the University of Illinois, as a material for the fabrication of calorimeter bombs, the use of illium has been extended to other applications. It is essentially a nickel-chrome alloy, in which a part of the nickel has been replaced by copper to improve machinability, and a portion of the chromium by molybdenum and tungsten to enhance resistance to corrosion. A typical analysis is as follows: Nickel 58·40%, chromium 21·80%, copper 7·95%, molybdenum 3·52%, tungsten 2·38%, manganese 1·72%, silicon 0·70%, iron 3·10% and carbon 0·32%. The results of corrosion tests against various inorganic reagents are given and technique for casting and machining is described. B. C. A.

584. Resinous Equipment Solves Corrosion. Anon. *Chem. Met. Eng.*, 1933, **40**, 201–203.—A resinous, phenol formaldehyde base material, which is resistant to many of the most corrosive chemicals, was developed about 15 years ago in Germany. Produced under the name of Haveg, it has been successfully used in the manufacture of anti-corrosive equipment. Haveg has a close impervious homogeneous structure and a smooth surface, which makes cleaning easy. The surface is non-absorbent and the material is

tough and does not deteriorate easily. It has a specific gravity of 1·6. The compressive strength is about 10,400 lb./sq. in., the bending strength 5600 lb./sq. in., and the resistance to shock high. It may be used at temperatures up to 130° C., and may be cooled from this temperature to freezing point without cracking. It is not affected by rapid temperature changes. The heat conductivity is low. It is easily machined and may be cut, drilled, planed and turned. Haveg has been used for handling most inorganic and organic acids (up to 50% strength in the case of sulphuric acid), weak alkalis and soap solutions. It is not affected by paraffin, chlorinated solvents, alcohol and petroleum oils. It is not attacked by aluminium chloride, chlorine, hydrogen sulphide, zinc chloride, etc. Its principal applications are in the manufacture of equipment for the dyestuff industry and the manufacture of storage and conveying vessels, centrifugal and plunger pumps, pipes, fittings and ventilators for the removal of corrosive vapours. A new form of Haveg has been recently developed to withstand the action of strong alkalis. G. R. N.

585. Automatically Indicating Internal Tube Gauge.—J. A. McMonagle, C. A. Pines and J. F. Williams. *A.P.I. Proc.*, Section III., Dec., 1932, 77. —A gauge for measuring the internal wear of still tubes is described and illustrated. The gauge was developed for cracking-still tubes and is made in any length. The contact points on one end are spring actuated, and the diameter is indicated automatically on the opposite end. Internal diameters are taken continuously throughout the length of tube at intervals, as the spring holds the small rollers in contact with the tube wall. A. O.

586. Benzole Recovery from Coal Gas (Continued). C. M. Wearing. *Gas World*, 1933, **98**, 311–316.—The author discusses the theoretical and practical aspects of absorption methods for benzole recovery and stresses the need for a reasonably low gas temperature, as dry a gas as possible, and freedom from tar fog and ammonia. The general principles of oil washing are explained, and theoretical conclusions are compared with practical results. Work has shown that the thickening of wash oils may be caused by oxidation, reaction with H_2S when crude gas is being washed, presence of tar fog and ammonia in the gas, polymerisation and cracking of the oil constituents and thickening due to increased proportion of high boiling constituents. The latter two effects result from the temperature cycle through which the wash oil is passed. Coal tar oils are considered to be superior to gas oils in regard to thickening since the former dissolve the resinous substances produced, whereas with the latter separation of sludge occurs, leading to cooler blockage and impaired heat transfer efficiency.

The author concludes that oil entering the washer should have been almost completely debenzolised, and should be only 1° C.–2° C. warmer than the gas, while oil thickening tendencies should be controlled by steady replacement of used by fresh oil at a rate determined by practice. Further, a good oil flow to gas flow ratio must be maintained, and the temperature of the stripped oil leaving the still must be above 100° C. W. E. J. B.

587. Patents on Cracking. Trinidad Leaseholds, Ltd. E.P. 389,871, 30.3.33. Oil is cracked by being brought into contact with hot gases resulting from combustion of gas in a porous refractory material.

P. Guichard. E.P. 389,971, 30.3.33. Conversion of heavy oil is effected by preheating under pressure followed by liquid-phase cracking in a series of reaction vessels, any one of which may be put out of the circuit.

H. Dreyfus. E.P. 390,846, 3.4.33. Vapour-phase cracking, the oil vapours being in the form of an annular narrow sheet 1/4 to 1/20 in. in width. A catalyst may be used.

A. E. Harnsberger. U.S.P. 1,900,057, 7.3.33. Cracking permanent cracked gas for the production of gasoline. The gas may be mixed with steam and catalysts may be used.

H. J. Halle. U.S.P. 1,900,105, 7.3.33. Cracked oil is discharged into an enlarged vapour separating zone, the latter containing a number of receptacles adapted to retain solid matter.

E. C. Herthel. U.S.P. 1,900,110, 7.3.33. Liquid-phase cracking in which the reflux condensate is cracked separately and at a higher temperature.

W. R. Howard. U.S.P. 1,900,113, 7.3.33. Reflux condensate is mixed under cracking conditions with cracked residue, a portion of the mixture being returned to the reaction zone into contact with the cracked gases.

N. E. Toomis. U.S.P. 1,900,116, 7.3.33. Cracked vapours are divided into two streams, one to the top of a vertical soaking drum and one to the bottom thereof. Vapour and liquid conversion products are withdrawn from an intermediate point in the drum.

D. J. Bergman. U.S.P. 1,900,153, 7.3.33. The feed is preheated by direct contact with cracked vapours, and the reflux condensate is blended with the feed before preheating.

G. Egloff. U.S.P. 1,900,170–1, 7.3.33. A multi-stage liquid-phase process in which volatile products are removed after each stage. The second patent specifies the removal of the more refractory oils after each stage.

O. H. Fairchild. U.S.P. 1,900,174, 7.3.33. A process in which heated oil is continually circulated through a soaking drum at such a speed that carbon is not precipitated therein.

W. G. Laird. U.S.P. 1,900,862, 7.3.33. Cracked vapours are passed into a fractionating tower and the resultant heavy condensate recycled. A partially cracked condensate is withdrawn from an intermediate point in the tower and cracked separately.

H. C. Kirk. U.S.P. 1,901,172, 14.3.33. Combined cracking and partial oxidation wherein no hard or coke-like carbon is formed.

A. E. Harnsberger. U.S.P. 1,901,592, 14.3.33. Vapour-phase cracking, the vapours being dried in an intermediate heating zone before heat treatment.

A. E. Harnsberger. U.S.P. 1,901,593, 14.3.33. Vapour-phase cracking in which the heat of the cracked vapours is used to crack the reflux condensate.

R. T. Pollock. U.S.P. 1,901,931, 21.3.33. A continuous process in which carbon is removed in a series of expansion chambers, any one of which may be "cut out" for cleaning.

C. P. Dubbs. U.S.P. 1,901,950, 21.3.33. A liquid-phase process in which the oil is passed successively through a series of retorts.

L. C. Huff. U.S.P. 1,901,969, 21.3.33. Vapour-phase cracking in which the heat for cracking is supplied by partial combustion in the cracking zone.

O. Behimer. U.S.P. 1,902,056, 21.3.33. Combined cracking and distillation system, the reflux condensate being cooled and returned into the column.

E. F. Nelson. U.S.P. 1,902,808, 21.3.33. Permanent gas is cooled by expansion and then passed in indirect heat exchange into a stabilising zone for cracked vapours.

R. Carter. U.S.P. 1,903,749, 11.4.33. Hot oil is brought into heat transference with hydrocarbon solids capable of destructive distillation.

G. Egloff. U.S.P. 1,904,362, 18.4.33. Conversion of incondensable hydrocarbon gas by heat and pressure, followed by treatment with ultra-violet light.

E. E. Stewart. U.S.P. 1,905,071, 25.4.33. A combined vapour and liquid phase process.

V. B. Browne. U.S.P. 1,905,436, 25.4.33. In order to prevent corrosion, cracking is carried out in apparatus composed of 4–8% of chromium, ·25–·5% copper, ·5–1·0% aluminium, the remainder being iron. W. H. T.

588. Patents on Coal and Shale. R. E. Goldsbrough. U.S.P. 1,903,568, 11.4.33. Production of motor fuels from coal tars and oils by injection of the latter, together with steam, into a heating zone at 450°–700° C. The zone is of 90% nickel-chromium alloy, containing small proportions of silicon, zinc, aluminium and iron. Iron oxide is injected into the heating zone in order to desulphurise the material.

K. Winkler. U.S.P. 1,904,586, 18.4.33. Recovery of liquid products from solid bituminous material by extraction with liquid hydrocarbons (I.B.P. above 300° C.) at 10 atm. press., and at a temperature of over 250° C.

E. O. Rhodes. U.S.P. 1,905,423, 25.4.33. Extraction of soluble matter from high-temperature coke-oven tar with a mixture of alcohol and acetone. The solvent is removed by distillation, to produce a creosote-like distillate and a pitch-like residue. W. H. T.

589. Patents on Hydrogenation. E. M. Clark. U.S.P. 1,902,015, 21.3.33. Oil and hydrogen are heated under pressure and then transferred to a reaction zone (750° F. and 100 atm.), from which gas and vapours are withdrawn and cooled under pressure. The condensate is expanded into a series of distillation zones and the residue returned to the reaction zone.

E. J. Gohr. U.S.P. 1,904,133, 18.4.33. An improved method for putting in operation an additional unit in a battery of continually recycling destructive hydrogenation units.

C. Krauch. U.S.P. 1,904,476, 18.4.33. Hydrogenation at 300–500° C. and at least 20 atm. press. in a reaction vessel internally coated with an alloy of aluminium, solid under the conditions of working.

M. Pier. U.S.P. 1,904,521, 18.4.33. Treatment of hydrogenation residues for the separation of oil from solid insoluble matter, by continuous extraction with a solvent.

H. Kaffer. U.S.P. 1,904,830, 18.4.33. Hydrogenation of the spirit from the low-temperature carbonisation of coal (3 hrs. at 350° C. and 110 atm.) in an autoclave and in the presence of active carbon. W. H. T.

590. Patents on Motor Fuel. D. E. Day. U.S.P. 1,902,221, 21.3.33. Removing gum-forming constituents by treatment with alkali solution under pressure at 350–500° F. followed by redistillation.

M. S. Darrow. U.S.P. 1,903,094, 28.3.33. Sweetening and decolorising by filtration through a bed of Fuller's earth (48·7%), sodium hydroxide (28·7%) and lead oxide (22·6%).

H. Rostin. U.S.P. 1,904,172, 18.4.33. Treatment of gasoline by passage, together with hydrogen, at elevated temperatures over freshly reduced porous iron ore (minette).

R. K. Stratford. U.S.P. 1,904,173, 18.4.33. Removal of corrosive sulphur by contact at 212–300° F. with an alkaline solution containing a naphthenic acid soap.

J. C. Morrell. U.S.P. 1,904,381, 18.4.33. Vapour-phase treatment of cracked gasoline with "earthy material" containing soda lime and a lead oxide.

J. C. Morrell. U.S.P. 1,904,382, 18.4.33. Sweetening distillates by conversion of mercaptans into mercaptides, by treatment with plumbite solution and then precipitating the mercaptides by exposure of the distillate to ultra-violet light W. H. T.

591. Patents on Lubricating Oil.—Matsunawa and Nozawa. E.P. 388,466, 2.3.33, describes a method of preparing a lubricant consisting of a mixture of mineral (cylinder) oil with 0·2% to 8% by weight of petrolene, a constituent extracted from asphalt and mineral pitch by means of benzine. This addition is stated to lower the surface tension of the oil and improve its lubricating properties. The mixture may be emulsified with lime water if desired.

S. B.

Sinclair Refining Co. E.P. 390,697, 13.4.33. Oils of viscosity upwards of 70 secs. at 100° F. Saybolt Universal are subjected first to a mild oxidation, and then to the action of nitrobenzine and sulphuric acid at the same time. This treatment is claimed to improve the general properties of the lubricating oil.

A. Henriksen. U.S.P. 1,901,240, 14.3.33. Dewaxing lubricating oils by adding a suitable solvent—*e.g.*, naphtha and a colloidal asphaltite, *e.g.*, Grahamite—chilling the mixture to the desired temperature and centrifuging while still cool.

E. W. Beardsley. U.S.P. 1,901,863, 21.3.33. Distillation of lubricating oils by means of injected neutral gas and no steam.

J. Stormonth. U.S.P. 1,903, 370, 4.4.33. A process for reconditioning engine, crank case and transformer oils. They are first heated to remove impurities and then treated with a reagent consisting of castor oil blended with 10% of mineral oil of high specific gravity at a temperature of about 160° F. The oil is then finally treated with superheated steam, cooled and centrifuged.

A. E. Pew, Jr. U.S.P. 1,903,407. Vacuum distillation of lubricating oils by adding an alkaline solution to a flowing stream of hot liquid oil.

A. A. Wells. U.S.P. 1,904,183, 18.4.33. Lubricating oil fractions treated in the liquid phase without precooling, with decolorising clays at 220° F.

C. R. Ewing. U.S.P. 1,904,213, 18.4.33. Asphalt and lubricating oil distillates submitted to pipe-still distillation, vaporiser of which is fitted with baffles.

E. R. Birkhimer, Pa. U.S.P. 1,904,402, 18.4.33. Separation of paraffinic and naphthenic hydrocarbons by extraction with benzaldehyde. The mixture is heated slightly above the temperature of complete miscibility, cooled and allowed to settle into two layers. The process is repeated and the benzaldehyde removed by vacuum distillation.

S. S. Kurtz. U.S.P. 1,899,969, 7.3.33. Uses benzonitrile instead of benzaldehyde.

C. Krauch, M. Pier and E. Anthes. U.S.P. 1,904,477, 18.4.33. Lubricating oils from solid non-asphaltic pyro-bituminous materials under high pressures at high temperatures.

I. K. Fuller. U.S.P. 1,904,682, 18.4.33. Oils are decolorised by percolation through clay.

R. E. Wilson. U.S.P. 1,905,201, 25.4.33. High vacuums distillation of lubricating oils in which staggered baffle plates are placed between the heating and condensing surfaces.

R. E. Wilson. U.S.P. 1,906,033, 25.4.33. Plant for vacuum distillation of lubricating oil fractions not employing steam.

W. S. E. C.

592. Patents on Asphalts and Fluxes. U.S. Pipe and Foundry Co. E.P 388,681, 2.3.33. An asphaltic coating for pipes which will retain plasticity at low temperatures (0° F.), yet not flow at higher temperatures (170° F.). An incompletely condensed phenolic aldehyde (5%) is added to the asphalt, and the mixture maintained at 450° F. until condensation of the phenolic resin is complete and the desired degree of plasticity obtained.

L. Kirschbraun. U.S.P. 1,902,305, 21.3.33. Continuous oxidation of asphalt, using thermal circulation, air being injected into a plurality of passage-ways connected to the bulk supply.

G. B. Coubrough. U.S.P. 1,905,156, 25.4.33. Asphalt is separated from residues by admixture with a diluent, followed by heating under pressure and then expanding the mixture into a vaporising zone from which asphalt is separated. S. B.

593. Patents on Fuel Oil.—A. Haeck. E.P. 389,925, 30.3.33. Homogenising fuel oil by heating in a closed system for some hours at 70°–100° C. The surface is then abruptly cooled to promote the formation of a film, which is allowed to precipitate slowly, carrying with it impurities and harmful constituents.

G. N. Harcourt. U.S.P. 1,901,238, 14.3.33. Recovery of "drip oil" from water gas tar by heating and spraying into a vaporising zone under vacuum.

W. Higburg. U.S.P. 1,901,872, 21.3.33. Removal of straight-chain hydrocarbons (sulphonation residue) from coal tar distillates or hydrocarbon mixtures and the conversion by heating of the sulphonation residue into cyclic and aromatic hydrocarbons and gases. W. H. T.

594. Patents on Gas.—Du Pont de Nemours & Co. E.P. 390,179, 22.3.33. Polymerisation of ethylene by contact with a liquid catalyst mixture. The latter consists of a cuprous salt and a salt of ammonium or of a tertiary amine, in which an acid (ionisation constant at least 10^{-4}) is incorporated.

I.C.I. E.P. 390,863, 13.4.33. Recovery of ethylene from cracked gases by washing the latter with a kerosine fraction which absorbs propylene and higher olefines.

A. S. Ramage. U.S.P. 1,900,997, 14.3.33. Un-condensible natural gas is converted into a liquid fuel by passage in admixture with steam over heated (1100° F.) ferric oxide. The resulting vapours are mixed with more steam and passed over metallic iron at 1300° F. and then condensed. W. H. T.

595. Patents on Special Products.—F. H. Reichel. E.P. 389,914, 30.3.33. A composition for use in producing flexible impermeable coatings comprising a soluble polymerised vinyl compound, a plasticiser and paraffin wax.

British Thomson-Houston Co. E.P. 389,816, 17.3.33. An electrical insulation compound comprising 40–50% of wax, 32–40% of colophony and 10–28% by weight of castor oil.

H. Kimura. E.P. 390,971, 20.4.33. An insecticide consisting of a petroleum oil extract of dried perilla nankinensis and insecticide powder, to which is added wintergreen oil, pine oil, Japanese pepper and peppermint oils.

R. A. Morgan. U.S.P. 1,902,514, 21.3.33. A process of clarifying dry-cleaning solvent. W. H. T.

596. Patents on Refinery Plant.—J. S. Wallis. E.P. 390,682, 13.4.33. An improved tray construction for fractionating towers, with special means for introducing liquid uniformly into the troughs and for maintaining a predetermined liquid level.

J. S. Wallis. U.S.P. 1,900,085, 7.3.33. A bubble tray fractionating tower with means for withdrawing products at different levels and for equalising the rate of liquid flow on the trays.

F. L. Kallam. U.S.P. 1,901,104, 14.3.33. A continuously operating condenser, the vapour pressure of the product automatically controlling the operation of the condenser in order to provide a uniform product of predetermined volatility.

W. T. Davis. U.S.P. 1,901,803–4, 14.3.33. Removal of coke from heating tubes by causing it to burn in an atmosphere of oxygen.

C. B. Forward. U.S.P. 1,903,810, 18.4.33. Vaporisation of oil in a series of coils, using super-heated steam as the heating medium.

R. Meijer. U.S.P. 1,903,929, 18.4.33. Apparatus for sweating paraffin.

P. E. Kuhl. U.S.P. 1,904,144, 18.4.33. Fractionating equipment with means for controlling the side stream leaving the tower.

S. R. Bolles. U.S.P. 1,904,196, 18.4.33. Distillation apparatus comprising a vapour-separating chamber, fractionating column and thermosiphonic reboiler the latter being positioned within the vapour chamber.

S. S. Smith. U.S.P. 1,904,334, 18.4.33. A rectifier having a series of horizontal tubes arranged to perform the function of plates. A series of vertical tubes are arranged in lateral alignment and connects with the horizontal tubes. W. H. T.

Class 700. Utilisation.

597. Pulverised Coal and Colloidal Fuel. H. Tollemache. *Colliery Guard.*, 1933, **146**, 569–571; *Iron Coal Tr. Rev.*, 1933, **126**, 453–454.—About 1,000,000 tons of coal are burned annually in pulverised form in this country as compared with six times that amount in Germany and over 40 times as much in the United States. Pulverised coal at a cost of 0·6d. per therm presents all the advantages as regards cleanliness, ease of handling and efficiency given by oil or gas. Increased application of this method of firing should result in great reduction in the operating costs in many of our industries, and increase their virility and competitive power. Colloidal fuel in many respects is superior as a boiler fuel, even to straight fuel. It is safer than oil and its steam-raising efficiency may be better than either coal or oil burnt separately. Colloidal fuel is more compact than either coal or oil, and for a given volume is the richest in heat units. The bunker space required for a ship burning colloidal fuel is 10% less than with a sister ship using straight oil, and 50% less than a similar coal-burning ship of equal steaming radius. The specific heat of colloidal fuel is about 26% less than for a ship burning straight oil. The opinion is expressed that the co-operation of the Fuel Research Board with the coal, oil and shipping industries, and the Admiralty, would bring about the successful development of colloidal fuel for commercial purposes, and place Great Britain in a leading position in this particular branch of fuel utilisation. Power & Fuel Bull.

598. Experimental Investigation of Flow in Oil Engine Injection Systems. S. J. Davies and E. Giffen. *J. Inst. Aut. E.*, April, 1933, 9–38.—The three main factors affecting the progress of recent years in regard to higher speeds in oil engines, according to the authors of this paper, are: combustion chamber design, fuels, and injection systems, and until comparatively recently, when more data has been available regarding fuels, the problem of combustion chamber design is the only one of the three to get much attention. The present paper deals in particular with an attempt to correlate the rate of the injection of the fuel into the cylinder with the action of the fuel pump. Details of an experimental investigation of this matter are described, and the results are compared with the results of an analytical treatment.

The first part of the paper is an analysis of the various wave motions set up in a fuel line, and shows the effect of constant, increasing and decreasing plunger velocities, on the actual injection. The effects of varying lengths and diameter of pipe are also dealt with.

The second part of the paper deals with the actual experimental results. The apparatus, of which a full description and illustrations are given, consisted roughly of a disc with a slot of definite width running at the speed of the pump shaft. The jet delivers at right angles to the plane of the disc, and by means of a collecting vessel in line with the jet on the other side of the disc, and a mechanism allowing the angular position of the disc relative to the pump shaft to be progressively altered, the fuel leaving the jet at any portion of the stroke can be measured. Various pump cams were used, and the effects of varying speeds, varying pipe lengths, and several other factors were fully investigated. The results bear out very well the conclusions reached in the analytical investigation. Some of the main conclusions reached from the investigation as a whole are as follows :—

(1) Injection characteristics cannot be inferred directly from pump action. The system must be considered as a whole.

(2) With suitable plunger motion any desired injection characteristic can be obtained.

(3) Change of speed alters the injection characteristic. A higher speed gives higher rate of injection, but not in proportion to speed. The injection lag is the same on time, but longer on crank angle. On crank angle the beginning of pressure release is roughly constant, but pressure release period increases with speed. C. H. S.

599. Fumes from Motor Vehicles, with particular references to those fitted with Heavy Oil Engines. A. T. Wilford. *J. Inst. Fuel*, 1933, 6, 131–142.—The degree of annoyance caused by visible and olfactory fumes from motor vehicles is closely connected with weather conditions. In very cold weather, due to failure of the engine to warm up quickly, fumes from the petrol engine are to some extent inevitable. This trouble cannot occur with the heavy oil engine, which is capable of taking its full load immediately following starting from cold. Quiet foggy weather gives rise to many complaints regarding fumes, which then become visible. Partially burnt lubricating oil is, in the author's opinion, the most common cause of fumes from motor vehicles, particularly petrol-driven ones. The fumes make their appearance as a white smoke, possessing a very characteristic penetrating odour, especially when castor oil is employed. The causes of partial combustion of the lubricating oil are various and are largely avoidable, *e.g.*, external leakage, allowing oil to come into contact with exhaust pipe ; fumes from crankcase breather ; grease or oil from rotating parts thrown on to exhaust pipe or heated brake drums ; over-lubrication of engine, worn pistons, piston rings or cylinders, resulting in defective seal between crankcase and cylinder, and final expulsion of oil vapour through exhaust pipe. A further source of smoky exhaust may be excessive dilution of the lubricating oil with fuel. In multi-cylinder petrol engines all cylinders do not receive the correct mixture required for complete combustion owing to difficulties in distribution so that the exhaust gases will inevitably contain products of incomplete combustion.

The exhaust gases of petrol-engined vehicles may contain many products other than CO when combustion is not complete, notably aldehydes, which are characterised by their pungent odour. Determination of CO however, provides a suitable measure of incomplete combustion. In view of the increased concentration of gases which occurs when idling it is very necessary to pay special attention to the requirements of slow running. In comparison with the spark ignition engine the C.I. engine possesses advantages which should help to ensure more complete combustion of fuel :—(1) There is no fuel distribution problem, owing to direct injection into the cylinder; (2) There is always present in the cylinder an amount of air in excess of that

theoretically necessary to effect complete combustion of the charge. Incomplete combustion is nevertheless a possibility in the C.I. engine, but it is evidenced by the production of free carbon and hydrogen, CO being almost entirely absent.

Whilst a certain amount of smoke was encountered with the first omnibuses operated by C.I. engines using the Acro system, this objection was eliminated by the adoption of the rotational air swirl system in October, 1931, and 100 vehicles are now operating in London streets. The aggregate mileage since that date amounts to about 2½ million. Data reported by various investigators regarding the CO content of samples of air from the streets of large cities are summarised. Exhaust gas analysis has been employed as a means of establishing and maintaining carburettor settings of petrol-engined omnibuses in London. The method of sampling is described. A modified Orsat apparatus is utilized for test purposes and its utility and limitations are discussed. A normal analysis shows that for a 4-cylinder gasoline engine the exhaust gases contain no CO when operating at full throttle, but 0·2% when idling. For a 6-cylinder engine the corresponding proportions of CO are 1·8% and 0·6% respectively. These figures indicate a much higher degree of completeness of combustion than usually regarded as attainable with a petrol engine under service conditions.

Exhaust gas analysis has also been of assistance in development work in connection with C.I. engines, but its application to controlling efficiency of these engines has not yet reached the stage of usefulness attained with the petrol engine. Analyses of exhaust gases from C.I. engines fitted to omnibuses show not more than 0·2% of CO whether operated under conditions of full injection or idling, and even when the engine is sluggish, or the fuel injection is increased to maximum without smoke. Fumes due to partially burnt lubricating oil are also likely to be less prevalent with heavy oil engines than with petrol engines. The future expansion of the C.I. engine as prime mover for road transport vehicles should, therefore, cause no anxiety regarding its possible effects on atmospheric pollution. R. A. E.

600. British Oil Engine Design. W. S. Burn. *Engineer*, 1933, **155**, 506–7.—Progress, during the last ten years, in the design and operation of British two-stroke, double-acting marine oil engines, has led to greatly reduced weight and fuel consumption, and the ratio of first cost compared with the latest steam installation is now only 1·5 : 1.

The development of this type of engine by Richardson, Westgarth & Co. is described with special reference to the overcoming of piston rod difficulties, improvements in airless injection systems, scavenging systems, combustion chambers, fuel pumps and gear controls.

The desirability of separating the three functions of scavenging, extra air charging and turbulence is stressed, and a system combining these three necessary components described in detail.

The modern cargo-boat oil-engine installation approaches very closely that of the steam engine both in appearance and equipment. J. M. F.

601. Synthetic Methanol as a Motor Fuel. D. A. Howes. *J. Inst. Petr. Techn.*, 1933, **19**, 301–331.—An account of a lengthy examination of synthetic methanol with respect to its value as a motor fuel. This examination included tests, on knock rating, thermal efficiency, maximum power output, miscibility with other fuels, effect of water addition, etc. G. R. N.

602. Oil and Motor Spirit from Coal. C. H. Lander. *Colliery Guard.*, 1933, **146**, 425–426.—The author was of the opinion that low-temperature carbonisation could take an important place as a means of reduction of

domestic smoke, but, as operations increased in magnitude, a problem of the disposal of the heavier fractions of the tar would inevitably have to be faced. Both the motor spirit and the fuel oil obtained from tar could be prepared so that they had qualities in no way inferior to those possessed by the natural material, petroleum. If a sufficiently high price could be maintained for the smokeless fuel made, the other products could compete in price with natural oils. The hydrogenation process was elastic, and could be used to produce mainly, or entirely, motor spirit, such as was required by the market at present, or heavier types of oil might be manufactured if there were large developments in light types of heavy oil engines for motor transport. Motor spirit could not compete with petroleum spirit at present on an equal footing. Technically speaking, it would be possible to manufacture our requirements of motor spirit and oils from coal, although unforeseen difficulties would undoubtedly arise. It involved, however, important political questions, upon which opinions differed widely. Power & Fuel Bull.

603. Coal Gas as Fuel. *Comm. Motor*, 1933, **57**, 316–318.—This article describes work carried out by the Gas Light and Coke Co., using compressed coal gas as fuel on a 4 ton Dennis lorry. To date, 1200 miles have been run, partly on experimental work and partly on routine delivery work. The equipment provided includes eight 1·76 cu. ft. cylinders containing 2800 cu. ft. of gas stored at 3000 lb./sq. in. This equals approximately 12 gal. of petrol, and is sufficient for about 70 miles of normal delivery work. The gas cylinders are housed between the body and chassis frame, three transversely on each side between the driver's cabin and the rear wheels, and the other two longitudinally at the rear. From the cylinders, which are interconnected, the gas passes to an automatic pressure-reducing valve which is controlled by engine suction and delivers the gas at about atmospheric pressure to a gas mixer which replaces a normal carburettor. An Amal flame arrester is fitted between the reducing valve and the gas mixer. The cylinders weigh about 1 cwt. each and are made of forged Vibrac alloy steel, machined internally and externally.

The gas charging installation consists of a small four-stage electrically driven Bellis and Morcom compressor fed with mains gas, which fills five permanently fixed, 5 cu. ft. cylinders, each 7 ft. long, at 5000 lb./sq. in. Various devices prevent the vehicle cylinders from being charged to a pressure in excess of 3000 lb./sq. in., and the cylinders are considered to be well protected from possible injury by collisions. W. E. J. B.

604. Use of Agricultural Products in the Manufacture of Chemicals to Blend with Motor Fuels. *Oil & Gas J.*, 16/3/33, **31** (43), 10; 30.3.33, **31** (45), 16.—A series of investigations has been carried out at Iowa State College to further consumption and use of agricultural products. The present report deals with alcohol production and its utilisation in motor fuel blends. To replace 1% of U.S. consumption of motor fuel with ethyl alcohol would require the equivalent of 68 million bushels of corn.

At the present time about 5% of the alcohol produced in the U.S. is made synthetically from ethylene, 75% is produced from molasses and 5% from cereals. The process costs involved in the preparation from grain are higher than from molasses but the by-products are more valuable. The average yield of 95% alcohol from corn is 2½ gal. per bushel, and the actual manufacturing costs exclusive of interest, depreciation, etc., are estimated at 6/8 cents per gal. A return from by-products of 7 cents per gal. of alcohol may be allowed.

Synthetic alcohol can be produced for 24 cents per gal. of 95% strength, and with molasses at 5 cents per gallon, alcohol from that source can be

produced at a similar price. It is estimated that in order to compete in this industry, with the present stage of technical development, corn must be available at a price not higher than 35 cents per bushel at the plant. The economics of the situation are discussed. With gasoline at its present low level price it is not possible for alcohol to enter into free competition except in blends with gasoline sold at a premium on account of higher anti-knock rating.

In order to render 95% alcohol miscible with gasoline in all proportions blending agents such as alcohols of higher mol. wt., acetone, basic amines, and some of the fatty acids may be used, and research work on this problem is in progress at the College. Gasolines possessing a high content of aromatic hydrocarbons and those containing large proportions of low boiling-point constituents are the more readily miscible with 95% alcohol. Ethyl alcohol in concentrations of 5/10% is said to decrease the gum-forming tendency of cracked gasolines. The claims made in literature concerning the merits of alcohol and alcohol-gasoline blends as motor fuels are summarized.

Tests carried out at the Iowa State College show that a gasoline of 56 octane number has its octane rating increased to 65 by the addition of 10% ethyl alcohol, and to 80 by the addition of 20%. Tests carried out in cars to compare the engine performance when using anhydrous alcohol-gasoline blends, containing 10% and 20% of alcohol, with that obtained when using gasoline only, show that the alcohol blend gave: (1.) increased anti-knock value and elimination of engine roughness; (2) no difference in ease of starting; (3) in some cases improved, and in other cases poorer acceleration. Preliminary tests made to compare the performance of 95% alcohol/gasoline/blending agent mixtures with gasoline only, show that the blends gave (1) improved acceleration, quieter running and more flexible engine performance; (2) easier starting and better running.

Between 200/300 fuel consumption tests have been carried out in a Cadillac V8 and a 1932 Studebaker on the road. The results indicate that certain blends of butyl alcohol, acetone, ethyl alcohol and gasoline give a mileage at least equal to that obtained from gasoline, but that anhydrous alcohol-gasoline mixtures give a lower mileage than gasoline except at speeds less than 25 m.p.h. No carburettor adjustments were made for the purpose of these tests, which are being continued under varying atmospheric conditions before definite conclusions can be drawn. Economic and legal aspects of the manufacture of alcohol and of its use as motor fuel in the U.S. are discussed. R. A. E.

605. Emulsified Asphalt Industry. J. M. Fain and A. W. Hixson. *Chem. Met. Eng.*, 1933, **40**, 180–183.—During the last ten years the manufacture of asphalt emulsions has considerably increased. In road construction the technique of laying the emulsion has so developed that successful results have been obtained under a variety of conditions. Asphalt emulsions are also used for curing concrete, making fuel briquettes, coating and impregnating stone, wood, metal and felt. Very stable asphalt emulsions have also found application as paint. Mixed with cement, sand and gravel emulsified asphalt is used to advantage as a binder in mastic flooring. It is also used as a cement for rubber and composition tile, insulating board, etc.; special uses such as these require that the emulsion should satisfy certain rigid conditions—*e.g.*, high wetting power, smooth fluidity, short setting period, maximum adhesivity. Paper can be made waterproof and moisture proof by incorporation of asphalt emulsion with the fibre either in the beater or the paper machine. An important use of asphalt emulsion is as a protective coating on steel and iron structures. Asphalt emulsions are classified as stable, intermediate stable, and unstable. Stable emulsions are those which are

not broken down by addition of strong electrolytes or by vigorous mechanical action. A prominent characteristic is that their dried film does not flow under heat, as the cellular honey comb structure surrounding each asphalt particle remains after coalescence and acts as a barrier to the inclosed asphalt. Mineral powders are largely used as emulsifiers, particularly bentonite. Unstable emulsions generally contain a soap as the emulsifying agent; they require less power to prepare than stable emulsions, though the technique of manufacture must be closely controlled. Emulsions of intermediate stability are obtained by first preparing an unstable dispersion containing particles having a size of approximately 10 microns, then stabilising this dispersion by addition of an agent such as protein, starch, or other carbohydrates. These emulsions may also be prepared by the addition of bentonite to an unstable soap emulsion. This type of emulsion often incorporates some of the important properties of the stable and unstable types. On drying it may leave a film more resistant to flow under heat than does the unstable type. It may have a setting time between that of the other two types and a stability towards electrolytes and mechanical agitation approaching the stable type of emulsion. The patent literature on asphalt emulsions is shortly reviewed and the tentative laboratory tests on this material are indicated. G. R. N.

606. Bitumen-Mineral Mixtures for Use in the Cold. W. Becker. *Asphalt u. Teer*, 1933, **33**, 270–275.—The viscosity of the bitumen is reduced with an oil to correspond to that of the bitumen at 180–200° C.

Comparative figures are given for penetration, ductility, softening point (K. & S.), dropping point (Ubbelohde), and setting point (Fraass) for a petroleum bitumen and a tar residue of similar hardness. It is shown that the bitumen has definite advantages over the tar residue, *e.g.*, the ductility falls for the former from 150–0 cm. over 23° C. (12° C. to −11° C.), while for the tar residue a similar fall occurs over 2° C. (11° C. to 9° C.).

Some details are given of the preparation of these mixtures (see also Abstr. Nos. 385 and 494).

Almost any stone, suitably resistant to pressure, frost, impacts, etc., can be used. It should be clean and dry and free from earth and clayey constituents. The addition of a small percentage of filler to stiffen the bitumen is advantageous. The size of stone depends on the purpose for which the mix is required, but in each case the larger-sized stones should predominate: *e.g.*, if the grading is 3–15 mm., at least 50% should be over 8 mm. C. C.

607. Reliability and Economy of the Diesel-Engined Locomotive and Rail Coach. A. C. Heap. *Engineering*, 1933, **135**, 454–6.—The information accumulated by the author appears to prove that certain types of the Diesel Locomotive and Rail Coach approximate very closely that of Steam Locomotives as regards reliability, whilst operation and maintenance costs are very considerably lower. The figures cover only approximately one half of the Diesel Locomotives, etc., in use, but show that aggregate yearly mileages, where particulars are available, have increased from approximately 21,000 in 1913 to nearly 4 million in 1931. The sizes up to 200 B.H.P. are by far the most common, with a total aggregate mileage of 15 million. The running cost, which includes fuel, oil, wages, maintenance and overhaul, works out at 7·17d. per mile for Diesel as against 17·13d. for steam locomotives operating under similar conditions of service. The Diesel-electric type appears to be the most popular as it comprises about 85% of the total.

Considerable data concerning both Diesel-electric and Diesel-gear drive as regards general features of design and particular advantages of each type are also included. C. H. S.

608. Petroleum as a Source of Paint Materials. C. I. Kelly. *J. Oil Colour Chem. Assoc.*, 1933, **16**, 95–127; *Oil & Colour Trades J.*, 1933, **83**, 715–720; *Chem. Age*, 1933, **28**, 240–1; *Petr. Times*, 1933, **29**, 347–9.—A description is given of the methods employed in the manufacture of the products directly from petroleum, ranging from "dry" natural gas, and natural gasoline, to asphalt.

In most cases, petroleum products for the paint trades are obtained by re-processing the normal refinery products from crude oil.

Pigments from petroleum are asphalt, lamp black and carbon black. The production of carbon black by the Channel Process is briefly detailed and a description of the Thermatomic Process is included, because it produces, in addition to a carbon black, hydrogen which is available from ammonia synthesis. Natural gas thus becomes indirectly a source of ammonia, which may be combined with carbon dioxide to give urea, a raw material for lacquer products, or it may be oxidised to nitric acid—a reagent for nitro-cellulose production.

After brief reference to the white spirit *versus* turpentine situation, there follows a discussion of the solvent powers and the evaporation rates of petroleum naphtha diluents. The suggestion is made that the usefulness of these petroleum products is most satisfactorily increased by blending with aromatic hydrocarbons synthesised from petroleum gases or by the production of high solvency naphthas by the hydrogenation process. The properties of a hydrogenated naphtha, a petroleum white spirit and a coal tar naphtha are compared in tabular form. Also, there is included a table denoting the properties of four Hydrogenated Naphthas having graded evaporation rates that make them suitable for use in different types of coating compositions.

Six general methods for the production of the higher monohydric alcohols are mentioned, stress being placed on the indirect hydration of olefines by way of the alkyl sulphates. The possibilities of direct hydration of olefines in the presence of suitable catalysts are indicated, and the use in America of catalytic methods for the condensation of the lower alcohols (ethyl alcohol) into higher alcohols (*n*-butyl alcohol) is mentioned.

Details are also given of the production of amyl alcohol through the chlorination of pentane, the polyhydric alcohols (glycols) from ethylene, and the trend of thought in the efforts to synthesise glycerides from glycerol and fatty acids made from petroleum.

In addition, the methods for the production of esters and ketones by modern methods are given, and of others.

A new resin made by the action of aluminium chloride on cracked petroleum is described, and manipulation data for its incorporation in a varnish are given. Finally, a chart is produced to show the steps in the manufacture of the various resins and lacquer materials that are being produced, or are possible, from petroleum products. C. I. K.

ABSTRACTS.

Class 100. Geographic Occurrence.

609. Imperial Oil Wells. J. T. Smith. *Times Trade Eng. Suppl.* (British Empire Products Number), 20.5.33, **776** (32), 37.—A general survey of the production of petroleum from oil fields within the British Empire during the past year and an indication of the conditions likely to prevail during the current year. The total production during 1932 showed no great change from the figures of 1931. As the production of oil in the British Empire is approximately only 2 per cent. of the world's output, the problem of Imperial preference in relation to petroleum products is difficult. W. W.

610. Petroleum Production in Germany. Anon. *Oil News*, 1933, **33**, 325, 633.—The north district of the Nienhagen-Hänigsen field is on the broad, sharply pitching radial upfold, trending west-north-west away from the salt plug. Here, most wells find production between 2460 and 3937 ft. There are eight producing sands in the area, but the bulk of the production is from the Wealden-Valendis Sand (Lower Cretaceous), and the Dogger. These sands represent old shore-line conditions sealed off by overlapping younger sediments.

In the Wietze-Steinforde field, production is found on the north-western and northern flanks of a salt plug, where steeply dipping Mesozoic beds are strongly faulted, the sands being sealed either by overlapping Tertiary or by low-angle overthrusts. Of the six producing sands, the Wealden, Upper Dogger (mid-Jurassic) and Rhät (Upper Triassic) are the best, the others being the Malm (Upper Jurassic) and the basal sands of the overlapping Upper Cretaceous. About 50% of the production is obtained by mining the Wealden at a depth of 1000 ft. and winning the oil by drainage or washing. The field was first opened in 1851.

The Oberg field obtains oil from a pitching radial anticline on the south-eastern flank of the Gross-Ilsede salt plug, and only from the Lower Dogger sand (Mid-Jurassic). Between 1881 and 1890 oil was obtained in the Oelheim-Eddesse field from the south-eastern flank of the salt dome near Oelheim. This was mainly from the Wealden. In 1928 a deep well was successful on the north-eastern flank near Eddesse, yielding oil from the Upper Dogger. Later the Rhät sand was picked up. The structure of this latter deep sand is highly complicated by overturning, block-faulting and transgressional overlap.

The Volkenroda field gives underground production from shallow wells drilled in the workings of a potash mine, 3000 ft. below the surface. Oil is found in the joints and crevices of the Haupt dolomite of Upper Permian age and underlying the salt series of the Zechtein.

Twenty-five salt domes have been discovered by geophysical methods in the north German plain, and two have been proved by drilling. In the Danube basin, torsion balance work has been carried out to find anticlinal folds and in the Thuringia and Danube basins magnetic surveys have been made to locate regional features in the basement rocks.

To test the flanks of the salt plugs for Mesozoic oil-sands, wells have been, or are being, drilled on the Hope, Jaderberg, Sottorf, Husum and Sehnde-Lehrte salt domes. Tests for Zechtein oil are being made on the Elm anticline 4.3 miles east of Braunschweig, the Hakel anticline 11 miles west of Stassfurt, and at a place 3.1 miles south-west of the Volkenroda field.

G. D. H.

Class 200. Geology and Origin.

611. Petroleum Geology. F. H. Lahee. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 548–557.—This paper deals with the growth of the relationship between geology and the petroleum industry during the last few decades. In the early days of the oil industry, the anticlinal theory was accepted by geologists as of primary importance in the location of oilpools, until, with ever increasing drilling, the possibilities of a variety of other structures became apparent. As a result of this, vigorous exploratory campaigns were launched in many States, and the more conspicuous surface indications of oil developed. With the passage of years, however, the discovery of reliable surface evidence became increasingly difficult, demanding more and more detailed work on the part of the field geologist.

When the value of sub-surface evidence came to be realised, coring was introduced, and its application has made such progress that to-day sub-surface geology has become of major importance. It is evident, therefore, that the chance of securing valuable geological evidence by coring wild-cat wells is well worth the small additional expenditure involved, particularly in view of the very low percentage of successful wild-cat holes. The necessity for co-operation between production engineer and geologist is now fully recognised, and the data on structure, lithology and characteristics of reservoir rocks and their contents, supplied by the latter, are vital to the elaboration of a successful production programme.

The most significant contribution made by petroleum geology to the industry in recent years is the conception of an oilpool as a complete unit. Until this conception and its relation to ownership rights vested in the surface is realised and accepted by all, rational plans of oil-field development cannot replace the present chaos of unrestrained production. A. L. G.

612. Determination of Permeability from Field Data. T. V. Moore, R. J. Schilthuis and W. Hurst. *Oil Weekly*, 22.5.33, **69** (10), 19.—The study of drainage of oil reservoirs has long been held back because a satisfactory method for measuring certain important properties of the reservoir rock has been lacking. One of the most significant of these properties is the permeability, which influences to a great degree the productive capacity and effective drainage areas of wells; and has, therefore, a direct bearing on such problems as the evaluation of producing properties and economic well spacing. In this paper a method for calculating this quantity from field tests made on flowing wells is developed and a few of the possible applications of information of this type are discussed. The results of using the method on field data suggest that a wider spacing of wells than that usually considered necessary will adequately drain a field if the production rate is kept low. L. V. W. C.

Class 300. Development and Production.

613. Coring in the Oklahoma City Field. R. W. Brunchli. *Oil & Gas J.*, 1.6.33, **32** (2), 12.—There is no evidence in the Oklahoma City Field that coring might cause fishing jobs.

If accurate records of everything that occurs on the wells were kept, improvements in coring would be possible. By studying these records it would be easy to single out the factors which control recovery and find ways to eliminate those factors which are causing trouble.

From the limited information available it has been possible to draw certain conclusions regarding the influence of core diameter and diameter of pipe on recovery and as to the desirability of using the largest possible core diameter and heavy drill-pipe. L. V. W. C.

614. Drill Pipe Stresses. M. Putnam. *Petr. World* (L. A.), 1933, **30** (4), 22-26.—An analysis of the present methods of drilling has been made possible by the installation of a number of special instruments for recording rotary drilling practice. These instruments record such data as drilling weight employed, applied torque, rotary table speed and footage drilled. The data secured also permits of at least an elementary analysis of the various stresses to which drill pipe is subjected. The six principal types of stress discussed are tension, compression, flexure, torsion, torsional shock or resilience and fatigue. With the bit off the bottom, hanging drill pipe is entirely in tension, the stress increasing to a maximum at the top of the pipe. Maximum tensile stress usually occurs while attempting to free stuck drill pipe (a table of maximum allowance pulls is given). When the bit is at the bottom, the stress in the lower end of the string changes to compression with maximum intensity at the bit. With low drilling weights the drill pipe will not flex, and there is little danger of pipe failure and crooked holes. Such weights are not ordinarily used, so that drill pipe is nearly always flexed during drilling. The load under which drill pipe will flex can be calculated by Eulers' " long column " formula (graph given). Using this formula, diagrams were constructed of : (i.) flexure of drill pipe in a normal hole, medium drilling weight ; (ii.) flexure of drill pipe in a normal hole, high drilling weight ; (iii.) flexure of drill pipe in a cavity ; and (iv.) flexure of drill pipe across a small cavity. Stress calculations were made by the bending moment method and by the elastic curve method. These indicated that the existence of cavities opposite the compressed portion of a drilling string is a logical explanation for a large percentage of drilling failures, and also if a cavity is encountered which causes the pipe to bend too sharply it will fail regardless of the width of the cavity and the drilling weight used. With regard to torsion, rotating drilling pipe is subject to a torsional shear, the amount of which depends on size of engine, steam pressure, etc., but in modern equipment these have not sufficient power to cause torsional failure. Drill pipe is subject to considerable torsional shock, but methods of determining the amount are unsatisfactory, so little can be said of the effect of this type of stress. Fatigue has been held responsible for many drill pipe failures, which results from the application of a large number of repeated stresses smaller in magnitude than the ultimate strength of the material. Tests, however, have shown that, in the absence of corrosion, repeated stresses as high as 45% of the ultimate strength can be applied indefinitely without causing failure. Maximum fatigue stresses probably occur at the top of the drill collar, and a table of stresses at this point is given which indicates that the fatigue failure theory is not important except when the drill pipe has been affected by corrosion. G. R. N.

615. Fluid Friction Principle Applied to Brakes for Drawworks and Sand Reels. L. G. E. Bignell. *Oil & Gas J.*, 18.5.33, **31** (52), 33.—A new hydromatic brake for the control of heavy loads in both cable tool and rotary systems utilises fluid friction to absorb the power developed, the same fluid also absorbing and carrying away the heat generated by the braking action.

The brake consists of a rotor with pockets on each side separated by inclined vanes. The rotor is surrounded by a stator having corresponding pockets separated by vanes which oppose those in the rotor. The hollow shell is filled with fluid, and the latter is discharged at the top of the brake case and returns to the supply tank.

When the load is descending and the brake is in operation, centrifugal force throws the fluid to the outer circumference of the rotor and into the pockets of the stator. The fluid is cut through by the vanes of the stator; the pockets in the stator in turn direct the fluid back to the hub, where it is again picked up by the rotor. The speed of the rotor determines the speed of the shaft. Energy is dissipated during the cutting of the fluid by the vanes. The fluid still retains some velocity whilst in the stator pockets, and the friction between the stator walls and the fluid dissipates more power. The final dissipation of power occurs when the fluid reaches the hub of the rotor, and in its passage into the rotor pockets it is cut by the vanes.

The dissipation of the energy results in a rise in temperature and hence it is necessary to replace the fluid. A circulating system must, therefore, be provided.

The hydromatic brake cannot completely supersede the mechanical brake, but it acts as an automatic governor. L. V. W. C.

616. Handling Stacks on Field Boilers. Anon. *Oil Weekly*, 29.5.33, **69** (11), 27.—To overcome the difficulties experienced in raising the stacks of field boilers, two holes are drilled equi-distant from the top to the bottom under the bonnet and near the edge of the plates by the smoke box door of the boiler. Two joints of 2 in. pipe are flattened at both ends and bolted to the boiler. The two free ends of the pipes are then brought together and a block attached.

This contrivance will act as a gin pole and is always in place ready to remove or replace the stack without the necessity of erecting a separate gin pole. L. V. W. C.

617. Preventing Corrosion by Use of Cement Lined Pipe. W. L. Baker. *Petr. Eng.*, 1933, **4** (8), 29.—Satisfactory results have generally been obtained in handling salt water and hydrogen sulphide mixtures by the use of cement lined pipes.

Investigations, however, have shown that the cements used were inefficient, due to their being relatively soluble, on account of their high lime content and to excessive shrinkage during setting.

Research is being conducted with a view to overcoming these two deficiencies. L. V. W. C.

618. Plugging Back Operations at Oklahoma City. F. Swindell. *Oil Weekly*, 15.5.33, **69** (9), 19.—The depth of wells, pressures, nature of the formations and the complicated water situation at Oklahoma City field have made the plug back jobs into a highly specialised engineering problem.

No general rule can be formulated owing to the varying conditions, but a representative plug back job would be as follows.

Externally upset tubing, preferably two inches diameter, is run in to within about three joints from where the bottom of the plug is to be placed. The last three joints are circulated until the action of the pumps indicates that tubing is on bottom.

When the tubing has reached bottom, the hole is washed thoroughly and circulation is obtained. Should circulation be impossible and it is desired to abandon the stratum which is to be plugged, a suitable clay must be placed in the bottom of the hole to perfect a seal. If only a part of the stratum is to be cemented and circulation cannot be obtained, cement is placed without establishing circulation.

The necessary quantity of cement is pumped into the tubing with water to follow to clear the tubing. The string is then raised just above the point at which plugging back is desired. The hole is then circulated until all the cement is washed out of the tubing. L. V. W. C.

619. Kettleman Hills Depth Record. W. A. Sawdon. *Petr. Eng.*, 1933, **4** (8), 38.—McAdams Well located on the North dome of Kettleman Hills, California, was spudded in on April 12th, 1932, and reached a depth of 10,580 ft. on April 23rd, 1933.

Coring was done below 7000 ft. and a total of 82 cores was taken. Four-inch special drill pipe was used down to 7000 ft., and a string of 3-in. drill pipe was then installed.

An 82-lb. mud was used to 10,200 ft. with the pressure sometimes running as high as 1400 lb. per sq. inch. At this point an admixture was added and the new fluid was kept at 90 lb. per gallon with the pump pressure decreased to 1225 lb. per sq. inch, and the pump speed reduced to ten strokes per minute.

Cement float shoes were used in the 18⅝-in. and 11¾-in., and a cement float collar and shoe on the 7-in. casing.

The three strings of casing were cemented. No special surface equipment is being used on the well. L. V. W. C.

620. Corrosion of Oil Well Tubing. W. F. Rogers. *Oil & Gas J.*, 25.5.33, **32** (1), 61.—From records of a large number of tubing failures the results show that the most common occur in the joint ends either from corrosion at the back of the threads, thread breaks or split joints. Corrosion of the joints is a particularly bad form of attack, and its relation to mill scale is being studied. The use of external upset seamless tubing has largely overcome joint end failures and split welds, particularly when the material has been fully normalised.

Where severe corrosive conditions prevail, the use of galvanised external upset seamless steel tubing is advocated. L. V. W. C.

621. Installation of Pumping Equipment in East Texas Field. D. T. Ross. *Petr. Eng.*, 1933, **4** (8), 24.—The installation of concrete foundations in the East Texas Field requires considerable care owing to low lying areas and poor soil conditions.

Proper attention to these foundations will reduce maintenance costs of surface equipment and aid in reducing lifting costs. L. V. W. C.

622. Well Pumping Equipment. H. Ledeen. *Petr. Eng.*, 1933, **4** (8), 63 (*cf.* Abstract 522).—This article deals with the means adopted to reduce the necessarily high prime mover speed to a desirable low pump speed. L. V. W. C.

623. Jet Pump Principles Applied to Oil Well Production Problems. M. P. O'Brien and J. E. Gosline. *Oil & Gas J.*, 25.5.33, **32** (1), 57.—The basic principle upon which the jet pump operates is the transference of momentum from a high velocity stream to a slower stream in contact with it. By this means there is a loss of mechanical energy from the system as a whole, but an increase of head of the suction stream and pumping thus results.

The conditions favourable for the use of the jet pump in oil production are low lifts and large rates of production, and these factors can be approached by using jet pumps in series. It is doubtful whether the more viscous oils can be handled by this method.

An example is given to show the method of applying the deduced equation. L. V. W. C.

624. Study of Petroleum Waters II. D. Chahnazaroff. *Mat. Grasses*, 15.11.32 (295), 9672; 15.2.33 (298), 9755; 15.3.33 (299), 9781.—In the first section of this study the origins and chemical composition of petroleum waters are discussed. It is shown that the Androussov classification of the origins of petroleum may be applied, suitably modified, to those of the waters.

The presence of atmospheric waters may have a profound effect on the composition, the work of G. Sherbourne Rogers and Kovalevsky being cited. The work of Vernadsky, Quinton, Daly and others on the salinity of sea water, and the work of Mme. Guinzburg-Karaguicheva on the micro-biological study of petroleum waters is then shortly reviewed. The second section deals with the methods of analysis of petroleum waters and their interpretation. The methods of C. Palmer, G. S. Rogers, F. Tickels, E. Parks, N. Jelkvist and the author are fully and diagrammatically described: these methods are based on the ordinary analysis for Cl, SO_4, Na_2O, CaO, etc., but differ in the evolution of an empirical formula to express salinity or its graphical interpretation. In the third section, the graphical representation of the salinity coefficients of petroleum waters at different depths in a petroleum well is shortly discussed. G. R. N.

625. Acid Treatment for Increasing Oil Production. R. B. Newcombe. *Oil Weekly*, 29.5.33, **69** (11), 19.—Hydrochloric acid is preferably employed in the treatment of oil wells, and an inhibiting substance is added to reduce attack. This inhibiting agent may consist of arsenic compounds, cyanides, organic nitrogen bases, organic sulphur compounds and various other substances.

If the strength of the aqueous hydrochloric acid solution is maintained between 10 and 15 per cent., only a relatively small amount of inhibiting agent will be needed to reduce to a minimum the corrosive action of the acid on iron and steel. In this state, the acid can be introduced into the well through the pump.

Where paraffin has prevented the acid from doing its work effectively, the application of a paraffin solvent to the well has been effective.

Chemicals are also being used for directing, controlling or retarding the action of the acid reagent in the hole.

The general method of treating wells with acid consists of putting in a charge of acid on top of the oil and finishing with a quantity of oil on top of the acid. Pressure may be applied at the well head with a pump to force the acid into the porous stratum, but this is generally unnecessary.

Uniform results have not been obtained and appear to have been more satisfactory in new fields than in old ones where the production is settled, gas pressure is low and water is more prevalent.

Inhibitors have eliminated many of the difficulties in the use of acid, but a few still remain. One difficulty is the speed and completeness with which the residues settle out due to the super saturated solution forming and the impurities in the lime rock reacting with the acid. L. V. W. C.

626. Production in East Texas. L. G. E. Bignell. *Oil & Gas J.*, 18.5.33, **31** (52), 10.—The East Texas Field has averaged over 1,000,000 brls. production per day, and the bottom-hole pressure has fallen about 6 lb. per day since May 1. When producing at from 325,000 to 400,000 brls. per day the pressure drop was less than 1 lb. per 1,000,000 brls.

On May 10th the average bottom-hole pressure was 1313, and statistics indicate that a majority of East Texas wells will cease natural flow at approximately 1200 lb. bottom-hole pressure.

A bottom-hole pressure below flowing pressure will be created in 30 to 60 days in many thousands of wells, and numerous wells will require pumping within 30 days.

Open flow has affected a number of wells to such an extent that they have either stopped flowing entirely or are unable to make their allowable production.

The rate of drop in bottom-hole pressure is increasing and the average was 5·95 lb. daily from May 6th to 10th.

The recent high withdrawal will delay repressuring.

In order to start a large number of wells flowing it will be necessary to swab or blow by air, and many hundreds will then only flow for two or three hours. This is the result of flowing the field at a rate many times greater than the rate of water movement into the field. Where a certain amount of pressure is maintained in the reservoir, the wells will flow, but this energy is rapidly being dissipated, and since water cannot move in as fast as the oil has been taken out, many wells will be damaged beyond repair if the field is shut down to enable water to build up pressure.

Pumping of the East Texas field is no longer economically possible at the present price of oil. L. V. W. C.

827. Study and Application of Subsurface Pressures and Temperatures in East Texas Flowing Wells. C. E. Reistle and E. P. Hayes. *Oil & Gas J.*, 25.5.33, **32** (1), 14.—The experiments carried out in order to study subsurface pressures and temperatures in flowing wells were divided into a number of sections. :—

(1) In order to study the sand performance representative wells were selected, and these test wells were produced at varying rates until equilibrium conditions were established in the reservoir. It was found that in all the wells tested the rate of production was a linear function of the pressure at the sand face.

(2) Pressure exerted at the bottom of the well and the positive work produced by expansion of the gas associated with the oil as it moves to a region of lower pressure causes vertical flow of oil and gas mixtures. This positive work must overcome the negative work of gravity, friction, acceleration and slippage of the gas through the associated oil. The tests were carried out to determine the minimum reservoir pressure capable of sustaining natural flow.

(3) Foam flow was found to exist when the volume of gas to oil in the flow string was less than 1.

(4) Mist flow occurred when the ratio of gas to oil was greater than 1.

(5) A method of calculating the pressure drop for the foam flow condition has been developed.

An example to illustrate the method of calculating the pressure drop has been worked out.

Charts are given showing the minimum pressure requirements of the flow string for different rates of production, sizes of flow, string and surface back pressures. L. V. W. C.

828. The Equation of State of Real Fluid. S. C. Bradford. *Engineering*, 1933, **135**, 439.—Following on the conception that, on account of molecular attractions, the temperature movements of liquid particles are not the same as those of gas particles at the same temperature, a new definition of temperature, *i.e.*, the mean kinetic energy of a particle of a perfect gas, or the temperature of a thermometer filled with a perfect gas, in equilibrium with the substance under observation, is expressed. Formulae are shown which take into consideration fluids which are associated, the change from liquid to vapour, surface tension and density of a liquid in deriving the equation of state of a real fluid. The resulting conception that molecules behave as attracting elastic spheres is remarkably in accordance with the observed properties of matter. W. W.

829. Gas Solubility in Bottom Hole Samples from the East Texas Field B. E. Lindsly. *Oil & Gas J.*, 1.6.33, **32** (2), 13.—By plotting gas liberation data to show the pressure volume relationship of a cubic foot of reservoir oil

as it expands from saturation to atmospheric pressure, the inaccuracies caused by the deviation of gas from ideal gas laws are completely eliminated. The amount of energy developed by a given volume of reservoir oil under isothermal expansion can be determined with reasonable accuracy.

Such data can be used advantageously in the design of flow strings, in other production problems and in the appraisal of properties to be operated under some unified method.

Tests carried out on East Texas oil have shown that liquid expansion takes place when the pressure is reduced from reservoir to 755 lb. per sq. inch and at pressures below 755, dissolved gas begins to evolve and the expansion of the mixture is caused principally by the liberation of dissolved gas.

Experiments carried out to evaluate the theory of oil propulsion by liquid expansion have shown that East Texas oil increased in volume by about 0·2% in expanding from 1620 to 1390 lb. per sq. inch. Calculations from this information indicate that approximately 4% of the oil produced may have been due to energy caused by liquid expansion, and the remainder of the production resulted from some other force, probably water drive.

L. V. W. C.

630. Proration in East Texas. K. C. Sclater. *Petr. Eng.*, 1933, **4** (8), 26.—Owing to the rapid development of the East Texas Field, no attempt has been made to enforce a reasonable well spacing program. The difference in well spacing is so great that any proration scheme based on acreage would be opposed by owners of wells on small tracts. The absence of a minimum well spacing program has proved one of the greatest obstacles in reconciling equities in the field by means of proration.

The study of physical changes occurring in the reservoir as oil and gas are withdrawn has been greatly assisted by an analysis of reservoir conditions by direct measurements of bottom hole pressure and temperature under both static and flow conditions. A well's potential production is more accurately indicated by bottom hole pressure measurements than by surface measurements, since they are not affected in value by the mechanical equipment in the well or by any artificial restrictions imposed on the well's flow. In addition, these measurements reflect the physical character of the sand.

The lack of suitable instruments and the cost of making subsurface measurements has militated against their use and a compromise has been effected by determining a well's potential by surface flow. The equity of proration based on potential tests cannot be compared with the method based on sand thickness, but under the conditions existing in East Texas it may be as equitable as any other method that is practicable.

L. V. W. C.

631. Bottom Hole Differential Regulators in High Pressure Gas Wells. H. G. Otis. *Oil Weekly*, 29.5.33, **69** (11), 16.—Experiments in the use of a removable differential regulator placed near the bottom of the tubing in a deep high pressure gas well indicate that complete flexibility in rate of withdrawal without any freezing problems is possible.

Bottom hole chokes, which eliminate freezing, are in use, but these usually permit of very little flexibility in rate of withdrawal. Due to critical flow, the rate of flow through the bean cannot be decreased by choking at the surface unless the pressure above the choke is at least one half of that beneath. Thus it is possible that the pressure above the choke might cause freezing at the surface.

The experiments were carried out in the Rodessa, Louisiana, gasfield, and the equipment consisted, in effect, of a weighted valve or differential regulator attached to a removable bottom-hole choke. The regulator was designed so that the pressure at its outlet would always be a pre-determined

amount less than that at its inlet. The whole assembly was lowered to the desired depth, under pressure.

The possible rate of delivery through equipment of this sort will depend upon the depth of the well, the tubing diameter, the line pressure, the bottom hole working pressure and the open flow capacity of the well. This latter factor governs the rate at which the bottom-hole working pressure will decline.

If a "mixing valve" which expands the gas, as needed, from the well casing head to the riser from the well tubing is so placed and designed that the excess heat in the tubing gas is utilised to prevent freezing at the valve, the capacities of the regulators can be considerably increased. The quantity of gas from the casing head, which can be warmed by the tubing gas, depend upon the temperature of the latter and upon the temperature and extent of the pressure drop at the mixing valve.

Thus the function of the bottom hole regulator will be to limit the delivery pressure of the tubing to one which will not cause freezing when reduced to line pressure, even though the rate of feed is pinched back almost to zero.

L. V. W. C.

632. Gravity Gathering System. Anon. *Oil Weekly*, 5.6.33, **69** (12), 20.—Injection of about one barrel of water to each two barrels of heavy oil has enabled the production from the Midway-Sunset district to be moved during the winter months through large gathering lines above ground without the addition of heat. The line has a gradual slope to the storage.

The injected water used has proved a very good moving agent and remains free, whilst the water produced with the oil separates quickly and assists in moving the oil.

All production flows by gravity to a large receiving tank, where the water is separated from the oil by heating.

L. V. W. C.

633. Electrically Operated Perforating Gun. Anon. *Oil Weekly*, 5.6.33, **69** (12), 26.—An electrically operated perforating gun has successfully perforated three strings of cemented casing. All the perforations were 0.45 in. diameter, and the shooting was carried out so that the shots were fired alternately on opposite sides of the hole.

The instrument is lowered into the well on a special armoured cable capable of carrying a load of 8 tons. The electric current is carried on a conductor within the cable.

The shots may be fired consecutively or in groups, and the gun may be built to fire in all directions.

L. V. W. C.

634. Bottom Hole Pressure Work at Kettleman Hills. C. L. Clark and C. B. Kimberlin. *Petr. World* (L. A.), 1933, **30** (4), 19–20.—Subsurface pressure records have been accumulated since 1931 at the Kettleman North Dome Field to aid in its development. In view of the uncertainty that any of the types of instruments on the market would be completely adaptable, the initial work was carried out with a shop-made pressure bailer with thermometer well attachment. This gave a reasonably correct idea of the pressures and temperatures encountered, and a suitable choice of instrument was made. This bailer was run on a line 0·065 in. × 10,000 ft. equipped with a stuffing-box, measuring device and reel. A pressure lock or "lubricator" was mounted on top of the flow connections, and the whole unit mounted on a 2-wheel trailer. Motive power was supplied, by hand crank, or from the rear wheel of a car or by a small engine. Pressure and temperature readings were taken in producing wells at regular intervals, preferably 24 hours after being shut in. Pressure readings were taken at four different

depths, thus permitting correction for any desired datum plane. The bottom-hole pressures data obtained in this way afforded a means of determining the rate at which drainage was affecting not only the various areas immediately involved but areas removed from them by a considerable distance. Similarly, this data was used to determine well potentials, to aid in the construction of pressure contour maps and in determining whether or not the producing horizon is separated into true zones. G. R. N.

635. Pressure Plant Fuel Problem. Anon. *Oil Weekly*, 5.6.33, **69** (12), 22.—On depleted oil pools where repressuring is being carried out, the problem of maintaining a sufficient supply of gas for the gas-engine-driven compressors has complicated matters.

On one pool in Oklahoma, it was necessary to begin repressuring with air. When the pressure had been brought up to several pounds above atmospheric, the gas from one section showed a much smaller percentage of air than that from other parts. Indications showed that the condition would be consistent.

Two systems of gathering lines were, therefore, laid, one to bring the rich gas and the other to bring the lean.

After the gas is compressed, two lines carry the rich and the lean gases to the fuel header. On the way to the header, the gases are passed through a blending tank in which intimate mixing is accomplished.

The gas mixture leaving the tank has at no time approached a point where an explosive condition might occur. L. V. W. C.

636. Open Flow Test in Gauging Reserve. T. V. Moore. *Oil Weekly*, 22.5.33, **69** (10), 16.—This article is a discussion of the significance of potentials of oil wells and a refutation of the points put forward in an article by J. S. Hudnall published in the *Oil Weekly* of May 1st, 1933 (*cf.*, Abstract No. 525). L. V. W. C.

637. Subsurface Storage of Oil and Gas in the Brea-Olinda and Lompoc Fields. F. C. Hodges and A. M. Johnson. Summary of Operations, California Oil Fields, 2nd Quarter, 1932, **4** (17), 5.—For the purpose of injecting gas into the reservoir sands of the Brea-Olinda Field, wells nos. 46 and 52 were selected, and later during the injection period, no. 55 was also used. During April, 1928, the first month of gas injection, approximately 34,000,000 cu. ft. of gas was pumped into no. 46 and 110,000 cu. ft. into no. 52. A total of approximately 590,000,000 cu. ft. of gas had been injected into the partially depleted oil sands through the three wells by the time injection was discontinued in February, 1929. The area affected by gas injection consisted of about 150 acres in which 17 wells had been drilled. Immediately upon injection of gas, two wells lying north of the injection wells showed an increase in pressure. As the injection of the gas continued, the wells north and east of the injection wells showed an increase in pressure. This showed that the gas was migrating up structure and easterly to the more depleted and closely drilled area. Even though gas was injected during the last stages under a maximum pressure of 830 lb. per sq. in., the casing pressures on closed-in wells indicated little or no movement of gas out of the previously affected area.

At the time no. 46 was closed in, and prior to gas injection, it was producing 150 brls. of oil/day on the pump. In August, 1929, the well was opened up and allowed to flow for thirty days to determine the effect of gas injection on the potential oil production of the property. It was then found that there was a pressure of 590 lb. on the casing and 360 lb. on the tubing, and that the daily average rate of production was 615 brls. of oil and 500,000 cu. ft. of

gas. During the time the well was allowed to flow, no decreases in either the gas or oil production were noticeable.

The success of the gas storage project in restricting the injected gas to a definite area convinced the officials of the Union Oil Company of California that the storage of oil underground was reasonably practicable. At this time the daily production of crude oil from the Santa Fe Springs field was 60,000 brls./day, and practically all available surface storage facilities were filled.

The Santa Fe Springs crude oil was considered a very desirable oil for injection into the repressured reservoir sands, as it differed considerably in both sp. gr. and sulphur content from the crude oil produced at Brea-Olinda. It was considered that the injection of the light Santa Fe Springs crude oil of 32 to 33° A.P.I. gravity should aid in freeing the heavier 14° A.P.I. gravity crude oil remaining in the sands and also in raising its gravity. Beginning August 15th, 1929, oil was pumped into no. 46 through the annular space between the tubing and the casing. In two weeks a total of 44,000 brls. of oil was injected into the sands under pressures that varied from 630 to 830 lb./sq. in., depending upon the rate of injection. At the same time, 800,000 to 1,250,000 cu. ft. of gas/day was injected through the tubing. Oil and gas injection was then discontinued for three weeks. No. 52, located 875 ft. west of no. 46, was then opened up to test the extent of the oil and gas injection and also the degree of oil and gas recovery. During the production test, the well produced at the rate of 530 brls. of oil/day with a pressure of 600 lb./sq. in. on the casing and 375 lb./sq. in. on the tubing.

On September 22nd, 1929, oil was again injected into no. 46 under a pressure of 665 lb./sq. in. and on the same day oil was first injected into no. 52 under an injection pressure of 700 lb./sq. in. Injection into both wells continued until October 10th, 1929, when several Christmas tree connections blew out on no. 46. From October 23rd to November 2nd, 1929, 24,300 brls. of oil were pumped through no. 50 into the reservoir sand under an injection pressure of 925 lb./sq. in. Oil injection was continued for varying periods into all three wells until March 20th, 1930, the final injections into nos. 46 and 50 being at 1400 lb./sq. in. pressure. When all the injection wells were shut in on March 21st, 1930, a total of 584,300 brls. of oil and gas in excess of 600,000,000 cu. ft. had been pumped underground into the reservoir sands. Two weeks after injection ceased, the closed in pressures on nos. 46, 52 and 50 were 750, 560 and 760 lb./sq. in. respectively. During the entire injection operations of both oil and gas, no special equipment or hook up was necessary or used. The force required for injecting the oil was furnished by three high-pressure pipe-line pumps located at the wells.

The degree of success of the experiment in underground storage of oil rests entirely upon how much of the injected oil can be recovered. As there is no evidence that the injected oil or gas is migrating from the property, or of water encroachment to trap the stored oil, and as in the affected area, the rock pressure has been built up through gas injection, conditions seem to indicate that 100% of the injected Santa Fe Springs oil will eventually be recovered. Moreover, oil produced from the property during recent production tests was found to be a lower gravity oil by a few degrees than the injected oil.

The operation of storing Santa Maria crude, enriched with natural gasoline from the gasoline plant at Santa Maria to increase the gravity from 23 to an average of 28° A.P.I. by injection into the Lompoc field, the crude of which is 19° A.P.I., started in October, 1930, and continued until January, 1931, during which period 241,750 brls. of oil were stored in wells no. "Purisima" 2 and "Purisima" 3. The injection pressures varied from

500 to 1250 lb./sq. in. depending upon the rate of injection and the gravity of the oil. As much as 3500 brls. of oil a day was pumped into these two wells. Since January, 1931, no oil has been injected in the Lompoc Field, and no production tests have been made since the suspension of oil injection, therefore, nothing is known with regard to the recovery of this stored oil.

In conclusion, the authors state that the outstanding advantage is the elimination of the cost of building surface storage which results in evaporation losses and fire hazard. It is estimated that the cost of surface storage for construction alone is 50 cents/brls. of oil. Added to this is the cost of insurance and a loss of 3 to 4%/year in evaporation of the most valuable constituents. Underground storage possesses further advantages. During times of flush production, it would serve as a relief to over-taxed storage and pipe-line facilities. It adds the possibility of recovery of native oil in the sub-surface reservoir in addition to that recovered by ordinary methods. By the injection of a higher gravity crude, it is believed a " loosening " action will take place which will free oil otherwise unrecoverable. The questionable disadvantage is that the major portion of the oil forced into the depleted sands may be lost beyond recovery. This hazard should be decreased to a minimum through careful attention to the following items :—

1. The type of structure and the character of the oil zone to be used as storage reservoir.
2. Selection of an injection oil higher in gravity than the oil native to the storage reservoir. In practice this difference has averaged 10°.
3. Preliminary repressuring with natural gas to furnish the energy for expulsion. W. W.

638. Lowering Production Costs in the Bradford Field. H. K. Dougherty and J. D. Gibson. *Petr. Eng.*, May, 1933, **4** (8), 32.—With the drop in the price of Bradford District Pennsylvanian grade crude oil it became necessary to reduce operating expenses and a number of economies have been effected.

The quantity of water taken by the wells is now metered by the pumper who pumps the oil wells in the five spot block instead of by special meter readers as previously.

The purchase of gas from outside sources has been eliminated by recovering the gas from the stock tanks by means of a vacuum pump. A vacuum regulator prevented pulling a vacuum of more than 0·2 in. of mercury on tanks and special relief valves prevented damage to the tanks in case the regulator failed to function. A further source of gas was found at the gauging tanks set at each well.

Plunger type working barrels with balls and seats of alloy steel have reduced the pulling of wells to a nominal figure.

Filtering the water used in flooding has had several indirect benefits, and the quantity of water pumped has been reduced by back-pressuring in the oil wells. The construction of an all metal power house to reduce fire hazard is explained in detail.

Development costs per acre have been reduced considerably by wider spacing. L. V. W. C.

639. Patents on Drilling Apparatus. F. W. Hild. U.S.P. 1,906,265, 2.5.33. Blow out preventer for rotary drilled holes.

C. E. Burt. U.S.P. 1,906,312, 2.5.33. Valve assembly for floating and cementing devices.

D. H. Reed. U.S.P. 1,906,416, 2.5.33. An inside casing cutting tool.

W. E. Sievers and O. Hammer. 1,906,427, 2.5.33. Well reamer.

H. D. Sandstone. U.S.P. 1,906,771, 2.5.33. Electrically operated well drill consisting of a double ended drill mechanism, lower bit to operate on

the bottom of the hole and upper bit to operate on the upper formations. A passage around the lower bit enables the drill body to pass.

E. S. White. U.S.P. 1,906,891, 2.5.33. Cement valves.

G. J. Armstrong. U.S.P. 1,906,895, 2.5.33. Overshot.

H. R. Standlee. U.S.P. 1,906,933, 2.5.33. Booster for well pumps.

W. J. Mitchell. U.S.P. 1,907,154, 2.5.33. Core drill.

R. A. Murdock. U.S.P. 1,907,155, 2.5.33. Coring device.

W. J. Williams. U.S.P. 1,907,167 and 1,907,168, 2.5.33. Mechanism for determining and recording deviation of wells from the perpendicular.

G. M. Eaun. U.S.P. 1,907,522, 9.5.33. Sucker rod connection.

P. Subkow. U.S.P. 1,907,608, 9.5.33. A constant gas oil ratio is maintained by varying the supply of gas in accordance with variations in the static head in the eduction pipe.

A. G. Gage. U.S.P. 1,907,947, 1,907,948, 1,907,949, 1,907,950, 1,907,951, 1,907,952, 1,907,953, 9.5.33. Oil well pump.

C. E. Reed. U.S.P. 1,908,049, 9.5.33. Rotary drill for deep wells.

W. Graaff. U.S.P. 1,908,141, 9.5.33. Apparatus for generating fire foam.

D. J. O'Grady. U.S.P. 1,908,174, 9.5.33. A drill pipe coupling comprising a ball and socket joint and a means whereby this joint may be made to operate to tilt a stem projecting from the lower end of the coupling.

R. D. Dodds. U.S.P. 1,908,227, 9.5.33. A drilling apparatus comprising an outer casing which can be set in the well, a tubular drill stem working inside the casing and cutters attached to the stem below the casing. The stem may be locked to the casing and the whole rotated. When the stem is lowered relative to the casing the locking device is released.

J. P. Walker. U.S.P. 1,908,581, 9.5.33. Oil and gas separator.

W. L. Foster. U.S.P. 1,908,594, 9.5.33. Underreamer.

R. G. Baker and H. J. James. U.S.P. 1,908,622, 9.5.33. Back off or holding tool for well casings.

J. C. Bell. U.S.P. 1,908,656, 9.5.33. Disc drill bit.

C. S. Crickmer. U.S.P. 1,908,693, 16.5.33. Disc bit.

J. Cuthill. U.S.P. 1,908,734, 16.5.33. Rotary drilling apparatus.

E. C. Johnston and J. T. Fowler. U.S.P. 1,908,762, 16.5.33. Cut off valve for drill stems.

N. H. Ricker and H. W. Fletcher. U.S.P. 1,909,075, 16.5.33. Coupling for double pipe sections.

N. H. Ricker. U.S.P. 1,909,119, 16.5.33. Bottom hole inlet for plunger lift devices.

F. L. Scott and L. E. Garfield. U.S.P. 1,909,128, 16.5.33. Lubricated roller bit.

F. L. Scott. U.S.P. 1,909,129, 16.5.33. Disc bit.

J. H. Oksenholt. U.S.P. 1,909,187. Core barrel.

G. S. Knox. U.S.P. 1,909,493, 16.5.33. Rodless pump.

C. S. Crickmer. U.S.P. 1,909,663, 16.5.33. Packer.

R. D. Dodds. U.S.P. 1,909,817, 16.5.33. Drilling apparatus.

W. A. Abegg. U.S.P. 1,909,925, 23.5.33. Core bit.

J. C. Wright. U.S.P. 1,909,994, 23.5.33. Reamer.

H. B. Zeigler. U.S.P. 1,910,079, 23.5.33. Back pressure.

G. G. Harrington. U.S.P. 1,910,161, 23.5.33. Blow out preventer.

R. G. Hamaker. U.S.P. 1,910,210, 23.5.33. Rotary bit.

S. E. Manning. U.S.P. 1,910,442, 23.5.33. Apparatus and method for cementing wells.

R. A. Leaky. U.S.P. 1,910,616, 23.5.33. Pressure bailer.

H. Osborne. U.S.P. 1,910,631, 23.5.33. Guide for drill pipe.

W. L. Pearce. U.S.P. 1,910,634, 23.5.33. Blow out preventer.

D. H. Reid. U.S.P. 1,910,637, 23.5.33. Outside pipe cutter.

P. E. Tarlton. U.S.P. 1,910,720, 23.5.33. Well surveying device.

M. F. Waters. U.S.P. 1,910,728, 23.5.33. Oil and gas separator.

R. Moss and H. U. Baker. U.S.P. 1,910,851, 23.5.33. Hydraulically operated casing perforator.

J. C. Fortune. U.S.P. 1,910,890, 23.5.33. Hydraulic feed for rotary drills.

H. C. Otis. U.S.P. 1,911,323, 30.5.33. Apparatus for controlling the flow from oil wells.

A. S. Uhler. U.S.P. 1,911,978, 30.5.33. Rock drill.

H. L. Gillespie. U.S.P. 1,911,997, 30.5.33. Device for determining the angle of a bore hole. L. V. W. C.

640. Patents on Crude Oil. M. de Groote. U.S.P. 1,908,129 and 30, 9.5.33. Breaking water-in-oil type emulsions by means of a demulsifying agent containing a nitrogenous sulpho fatty acid. The latter is characterised by direct linkage between the carbon of the carboxyl radicle residue of the sulpho fatty acid and the nitrogen of the nitrogenous body. In U.S.P. 1,908,130, the demulsifying agent contains a halogenated sulpho fatty body in which the halogen is directly attached to the fatty acid radicle.

M. de Groote. U.S.P. 1,910,680, 23.5.33. As above, the demulsifying agent consisting of a sulpho-abietene acid body selected from the class comprising acids, salts and esters.

B. T. Brooks. U.S.P. 1,911,795, 30.5.33. Separation of gases from a flowing stream of oil followed by their treatment to remove hydrogen sulphide. The remaining gases are recycled counter-current to the oil stream.

W. Brown. U.S.P. 1,911,797, 30.5.33. Emulsions of oil and water are resolved by agitation with a relatively minute quantity of insoluble zeolite and a large quantity of insoluble material preferentially wetted by one of the emulsion constituents. The extent of preference is not substantially less than that shown by sand for water or iron sulphide for oil.

G. Meinzer. U.S.P. 1,911,839 and 40, 30.5.33. Breaking oil-in-water emulsions by suspending in the latter, a plurality of dissimilar solid substances having the joint property of resolving the emulsion into its constituents. A stream of gas is used as the agitating medium.

T. Wayne. U.S.P. 1,912,330, 30.5.33. A demulsifying agent comprising a complex water-soluble condensation product resulting from the interaction of organic bodies containing resinophore groups. Examples are, an aldol and an amide derivative of carbonic acid, anisole and formaldehyde, etc.

W. H. T.

Class 400. Transportation, Storage and Distribution.

641. Bureau of Standards Publication on Stray-Current Electrolysis. E. R. Shepard. Bur. Stand. Cir. No. 401.—The object of this publication is to provide an index and summary of investigations, relative to stray-current electrolysis and its mitigation. A paper entitled "Surface Insulation of Pipes as a Means of Preventing Electrolysis," by B. McCollum and O. S. Peters, Technologic Paper No. 15, January 5th, 1914 (out of print) give conclusions on tests made on a large number of paints, dips and fabric wrappings to determine their protective value as pipe coatings. Such coatings are, with few exceptions, of no value whatever for protecting pipes from electrolysis when applied in the positive areas near power houses. In negative areas, they may be of considerable temporary value in reducing the current picked up by the pipe, and in that way indirectly they may reduce damage in

positive areas. The results of these tests are not to be considered as throwing light on the value of the coatings for protecting various metals from natural soil corrosion.

The above investigators, together with E. B. Rosa, deal with Electrolysis in Concrete in Technologic Paper No. 18, March 19th, 1913. Among the observations made are :—the addition of a small amount of salt (a fraction of 1%) to concrete (as is frequently done to prevent freezing while setting) has a two-fold effect, viz., it greatly increases the intial conductivity of the wet concrete, and it also destroys the passive condition of the iron at ordinary temperatures, increasing the rate of corrosion and consequent tendency of the concrete to crack. Further, reinforced concrete structures built in contract with salt water, are more susceptible to electrolysis troubles than concrete not subjected to such influences.

Specimens of normal wet concrete carrying currents increase their resistence considerably in the course of a few weeks.

The rise of electrical resistance is probably due to a number of causes among which are the precipitation of $CaCO_3$ within the pores of the concrete, thus plugging them up. A slight amount of salt tends to prevent this precipitation and interferes with the rise of resistance.

If reinforced concrete could be thoroughly water-proofed, it would greatly increase its resistance and diminish the danger from the anode or cathode effects. Water-proofing membranes, etc., properly applied to the surface may have considerable effect in preventing the entry of earth currents into the concrete.

A third paper, "Electrolytic Corrosion of Iron in Soils," B. McCollum and K. H. Logan, Technologic Paper No. 25, June 12th, 1913 (out of print), contains the results of some of the earliest laboratory work of the Bureau of Standards on electrolytic corrosion, particularly on the effects of moisture, temperature, current density, and other factors on the efficiency of electrolytic corrosion in soils.

The fourth paper, "Earth Resistance and Its Relation to Electrolysis of Underground Structures," by B. McCollum and K. H. Logan, Technologic Paper No. 26, Dec. 20th, 1915 (out of print), deals with the resistivity of the soil in which metallic structures are buried. Three methods of measuring the specific resistance of the soil, two of which do not require the removal of the soil from its original position, are described. Results by each method are compared, and it is shown that all three methods are satisfactory for practical purposes, although each has advantages over the others under certain conditions.

The fifth, seventh, ninth and tenth papers are entitled "Special Studies in Electrolysis Mitigation," and are respectively :—

I. "A Preliminary Study of Conditions in Springfield, Ohio, with Recommendations for Mitigation and Control," E. B. Rosa and B. McCollum, Technologic Paper No. 27, June 19th, 1913 (out of print).

II. "An Experimental Test on a System of Insulated Negative Feeders in St. Louis," E. B. Rosa, B. McCollum and K. H. Logan, Tech. Paper No. 32, Dec. 27th, 1913 (out of print).

III. "A Report on Conditions in Springfield, Ohio, with Insulated Feeder System Installed," B. McCollum and G. A. Ahlborn, Tech. Paper No. 54, Feb. 5th, 1916 (out of print).

IV. "A Preliminary Report on Electrolysis Conditions in Elyria, Ohio, with Recommendations for Mitigation," B. McCollum and K. H. Logan, Tech. Paper, No. 55, Jan. 22nd, 1916 (out of print).

The sixth paper is entitled "Methods of Making Electrolysis Surveys," B. McCollum and G. H. Ahlborn, Tech. Paper No. 28, Aug., 1916 (out of print), superseded by Tech. Paper No. 355 (see the seventeenth paper below).

The eighth paper, "Electrolysis and Its Mitigation," E. B. Rosa and B. McCollum, Tech. Paper No. 52, 2nd ed., Nov. 25th, 1918 (out of print), contains a comprehensive discussion of various methods of mitigation of electrolysis.

The eleventh, twelfth, fourteenth and fifteenth papers are only applicable to electric railway problems.

The thirteenth paper, "Influence of Frequency of Alternating or Infrequently Reversed Current on Electrolytic Corrosion," B. McCollum and G. H. Ahlborn, Tech. Paper, No. 72, Aug. 15th, 1916 (out of print), describes the determination of coefficients of corrosion for iron and lead in soil with varying frequencies of alternating or reversed current, some direct current tests being made as a check on the methods. One of the results shows that the reduction in corrosion due to periodically reversed currents appears to be due to the reversibility of the corrosive process.

The sixteenth paper, "Practical Application of the Earth-Current Meter," B. McCollum and K. H. Logan, Techn. Paper No. 351, Aug. 18th, 1927, describes the theory, calibration and application of an instrument developed for the quantitative measurement of stray currents at or near pipe surfaces. Although it is not well adapted for general electrolysis surveys because of the time and expense involved in its use, the fact that quantitative and definite data can be obtained with it at specific locations renders it invaluable in the interpretation of other and more general electrolysis measurements.

The last paper, "Electrolysis Testing," B. McCollum and K. H. Logan, Tech. Paper No. 355, Sept. 28th, 1927, supersedes Tech. Paper No. 28, entitled "Methods of Making Electrolysis Surveys." The need for a revision of this latter paper was brought about by the development of the earth-current meter. W. W.

642. Oil Tanker Design. H. H. Hagan. *Shipbuilding and Shipping Record*, 1933, **41**, 508–510.—A short discussion on the design of oil tankers in relation to the old and new freeboard rules. A graph shows that under the new rules the B/d ratios of tankers on a base of length of ship are lower, which, generally speaking, implies least resistance. With regard to stability, a graph of GZ values is given which shows that this is not affected by the lower B/d ratio. With the new freeboard rules tankers carrying light oils can be designed to make full use of the available capacity, but vessels carrying heavy oils can still be loaded only to about 80% of available capacity. The general arrangement of the tanker is now fairly well standardised; a recent change has been the substitution of two longtitudinal bulkheads for one bulkhead combined with summer tanks. Another change that is suggested is that of the cargo hold forward and the author considers that this hold, which is seldom employed, should be cut down by increasing the fore peak and arranging a forward ballast tank. The size of the pump rooms and engine room might also be increased with advantage. In conclusion, the author gives a graph of dimension curves for tankers which can be considered sufficiently accurate for purposes of preliminary design. G. R. N.

643. The "Volugraph." *Revue de Metrologie Pratique, Partie Officielle*, 1933, 1694–1701.—An apparatus for measuring and distributing motor spirit, and known as the "Volugraph," has been admitted for verification by the French Ministry of Commerce. It is fully described and illustrated. E. B. E.

Class 500. Properties and Their Determination.

644. Reversion of Refined Lubricating Oil Distillates from a Burmah Crude Oil. A. R. Bowen. *J. Inst. Petr. Techn.*, 1933, **19**, 364–375.—An account of experiments on the refining of distillate lubs. from Indaw crude oil. The extent of reversion of these distillates before and after refining with acid, liquid SO_2, earth, soda and distillation, etc., was measured by observing the Lovibond tint after 6 hours' heat treatment at 210° F. The action of ultra violet light was also noted. G. R. N.

645. Photo-electric Colorimeter for Measuring Colour Intensities of Liquid Petroleum Products. B. W. Story and V. A. Kalichevsky. *Ind. Eng. Chem., Anal.*, 1933, **5**, 213–216.—In most methods of measuring colour of petroleum products, a large personal equation is apt to give erratic results which are not reproducible. This difficulty can be largely overcome by the employment of the photo-electric cell. Model 594, manufactured by the Weston Electric Instrument Co., gives a relative sensitivity for hue which closely approximates to that of the human eye. It generates its own current in amounts sufficient to be measured directly; its response is quick and it stabilises rapidly without fatigue. The colorimeter consists essentially of a photo-electric cell connected with a micro-ammeter, an oil cell, and a uniform source of light. For the latter, a Mazda projection lamp is used and gives very little loss in intensity at a constant voltage, even after several months of service. It is, of course, essential to operate the lamp at constant voltage. In setting up the colorimeter the photo-electric cell was made stationary and the oil cell was fastened directly in front of the photo-electric cell, also in a fixed position. The lamp was made movable. The colour of the oil under examination could be expressed as a function of the current with a stationary source of light, or as a function of the distance if the light is made movable. The latter method was used and experimental results show that an oil which appears dark to the eye will also be graded darker by the photo-electric colorimeter.

The valuation of lubricating oils by this means does not take into consideration attributes of colour such as hue and saturation. These latter might be assessed by means of the same colorimeter equipped with colour filters. R. E. D.

646. Estimation of Latent Heats of Vaporisation. J. H. Arnold. *Ind. Eng. Chem.*, 1933, **25**, 659.—The empirical rule of Hildebrand as expressed by Lewis and Weber and improved by McAdams and Morrell is shown to be an incomplete form of an accurate empirical equation due to Dieterici and tested by Mills. Graphical representation of the available calorimetric data indicates that the Dieterici equation is reliable to 5%, or better over the range from room temperature to the critical point. W. H. T.

647. Analytical Steam Distillation of Lubricating Oils. R. N. J. Saal and C. G. Verver. *J. Inst. Petr. Tech.*, 1933, **19**, 336–363.—A lecture with discussion on the results obtained by subjecting lubricating oils and other high-boiling petroleum fractions to distillation with steam at a constant temperature under controlled conditions. G. R. N.

648. Effect of Graphite on Lubricating Properties of Oils. M. A. Boutaric and M. R. Amiot. *Ann. des Comb. Liq.*, 1933, **8**, 129–31.—Before studying the influence of graphite on the adhesion of lubricating oils to metallic surfaces, measurements were made of the viscosity and surface tension of "Vaseline Oil" and castor oil, alone and containing small quantities of "oil-dag"

and " Castor-dag " respectively. These properties were only slightly affected by the colloidal graphite, the viscosity at 26° being increased approximately 1% and the surface tension being reduced by approximately the same amount.

Measurements of interfacial tension, oil-mercury, showed that the graphite enhanced the adhesion qualities of both oils, more especially of the " vaseline oil " (abs. visc. at 26°, 0.82), and it is deduced that this would seem to play an important rôle in lubrication.

This belief is not apparently confirmed by centrifugal experiments (see Abstract No. 1445, 1931, for method employed) in which the weight of adhering oil was the same with and without graphite in it. The authors claim that in reality the two conclusions are not in conflict, because the thickness of the oil layer on the metallic plate after centrifugal treatment is very great as compared with the monomolecular layers in which the good lubricant qualities of graphite have been noted under service conditions. C. I. K.

649. Suspended Level Viscometer. L. Ubbelohde. *J. Inst. Petr. Techn.*, 1933, **19**, 376–420.—A comprehensive account of the theoretical and practical aspects of the phenomenon, the suspended liquid surface, and its application in the design of a simple, accurate viscometer. G. R. N.

650. Windshield for Saybolt Viscometer.—F. Vitovec. *Ind. Eng. Chem., Anal.*, 1933, **5**, 212.—The shield described has been designed to fit beneath the American Instrument Company's Saybolt viscometer. It consists of a window-glass frame constructed to overcome the inconvenience of air currents in a large laboratory blowing the fine stream of oil out or around the opening of the cup. R. E. D.

651. Determination of Absolute Viscosity. M. Louis and M. Peyrot. *Ann. des Comb. Liq.*, 1932, **7**, 1055–1061.—The authors point out: (1) whilst viscosity is very important industrially, its measurement is far from being obtained with desirable accuracy; (2) commercial viscometers (Redwood, Engler and Saybolt) function in the turbulent régime with oils of low viscosity and cannot give precise values; (3) approximate determination of viscosity is possible by the measurement of efflux times of oils from ordinary laboratory apparatus, such as pipettes, burettes, etc., which, however, have to be calibrated with oils of known absolute viscosity and which are useful only at room temperatures. Calibration curves are given for ten glass apparatus, such as the above, and also for an Engler viscometer, all of which were used with eight oils whose absolute viscosities had been determined with a " Louis " viscometer; (4) exact determination of viscosity demands the use of viscometers having long capillaries and which can be maintained throughout at a constant temperature.

Secondary absolute viscometers which are more suitable than " absolute " models for industrial laboratories give the absolute viscosity according to the formula $n = K.d.t.$, but the determination of the value of the constant K is a very delicate problem.

A discussion on Viscosity Standards follows, and the four essential characteristics of such standards are enumerated: (1) a low-temperature coefficient; (2) they should be non-colloidal and non-plastic; (3) constant properties (non-hygroscopic, etc.); (4) reasonable price and ease of preparation.

Water is the best known liquid which is easily obtainable pure, but its viscosity is to low for the standardisation of large-diameter capillary viscometers. Oils themselves are available for the standardisation of a wide range of viscometers of this type. They are not susceptible to changes over a period of several months. They are not hygroscopic and non-volatile at

ordinary temperatures. However, they have an inconvenient viscosity-temperature coefficient, which increases as the viscosity of the oil becomes very large. When oils are used as standards, rigorous temperature control (1/10th of a degree) is essential and the temperature itself should be accurately known.

Dibutyl phthalate (0·209 poise at 20°) is no more serviceable than a mineral oil of equal viscosity at the same temperature because its vicosity/temperature coefficient is no better. Carefully chosen oils seem to be the most suitable viscosity standards. C. I. K.

652. Thermal Decomposition of Petroleum under High Pressure. T. Kato. *J. Soc. Chem. Ind. Japan*, 1933, **36**, 226B.—It is shown that loss due to carbon deposition and uncondensable gas increases with pressure, especially over 200 atm. pressure. Increase in specific gravity indicates that polymerisation follows cracking at above 400° C., particularly at pressures above 200 atm. Both cracking rate and gasoline yield decrease with pressure-increase, due to decrease of oily product. Iodine values also decrease with pressure-increase (from 50 to 10), this showing an increase in degree of saturation of the cracked gasoline with pressure. W. H. T.

653. Mechanism of Flame Movement. Part III. Speed of Flame in Currents of Mixtures of Methane and Air. H. F. Coward and E. H. M. Georgeson. *J.C.S.*, 1933, 546–551.—The speeds of flame in various mixtures of methane and air (7–13% methane) moving as currents in a glass tube, 2·45 cm. in diameter, were determined. It was arranged that the flame should travel along the tube in one direction only. When the flame was propagated from the open to the closed end of the tube the increase in speed of uniform movement due to the current was greater than the mean speed of the current but less than the axial speed. For example, with a mean current speed of 200 cm./sec., the increased flame speed is about 215 cm./sec., whereas the axial speed of the current is about 265 cm./sec.

In all but the slowest burning mixtures the uniform movement of flame gives place to a vibratory movement when the flame has travelled about one quarter to one third of the length of the tube from the open to the closed end. The increase in mean forward speed during the vibratory movement was in general somewhat greater than the mean speed of current, but less than the axial speed; for small current speeds, however, the increase in speed was less than the mean current speed.

In the propagation of flame from the closed to the open end of a tube, the speed was high and the results were irregular; however, the flame speed was not far greater than the sum of the speed of the current and the speed of the flame in the absence of a superimposed current. W. E. J. B.

654. The Naphthenic Acids in Petroleum. E. Pyhala. *Matt. Grasses*, 15.3.33, (299), 9786–9788.—Published work on petroleum gives the impression that naphthenic acids exist in petroleums in the same form in which they have been identified in the distillates. It is known that the acids obtained from the crude petroleum by extraction is quite different from those isolated from the distillates. The former are oily tars, black in colour, with a relatively low acidity, and which cannot be refined; the latter are much lighter in colour, more or less viscous and of relatively high acidities.

The acidity of different crude petroleums varies greatly according to its origin. Russian petroleums (Balachany, Sobuntschi, Bibi-Eibat) have low acidities, whilst Roumanian petroleums have high acidities.

It is not possible to draw conclusions on the acidities of crude petroleums from naphthenic acid content. Crude petroleum contains other acids besides

naphthenic acids. The naphthenic acids appear to be masked in the crude petroleums, and are liberated in the distillates on distillation. One cannot, therefore, calculate the naphthenic acid content of crude petroleums from the acidity index. S. T. M.

655. Determination of Nuclear Halogens in Organic Compounds. W. A. Cook and K. H. Cook. *Ind. Eng. Chem., Anal.*, 1933, **5**, 186–187.—The authors here discuss and develop the Stepanow method for the determination of nuclear linked halogens in organic compounds. Favrel and Bucher contend that successful application of the above method depends on the proportion of sodium used, also the temperature of the reaction mixture during the reduction; they propose substituting isoamyl alcohol in place of ethyl alcohol. They also dilute the reaction mixture, after reduction, with water and extract with additional portions in a separating funnel. The water extract after acidification is treated with an excess of silver nitrate and the halogen is determined gravimetrically as silver chloride. A detailed description is given of the modified method of Drogin and Rosanoff. In outline it consists of adding absolute alcohol and sodium in predetermined quantities to the sample of the organic compound. Gentle warming of the reaction mixture effects the reduction in one hour. After dilution with water and acidification with nitric acid, the silver halide is allowed to coagulate and is then filtered off. The halogen is then determined volumetrically, using ammonium thiocyanate. The authors find that it is necessary to operate a blank at the same time. A list of experimental results shows very good agreement with theoretical. R. E. D.

656. Mono or Di-Nitrotoluene from Shukoko Crude. M. Mizuta. *J. Soc. Chem. Ind. Japan*, 1933, (**36**), 117B.—Gasoline from Shukoko crude (sp. gr. 0·785, 47% aromatics, 20% naphthenes and 33% paraffins) was first distilled to give a fraction boiling between 105–108° C. (sp. gr. 0·796, 49% toluene, 25% naphthenes and 26% paraffins). To this fraction (650 gms.) cooled to —10° C., was added 960 gms. of nitration mixture (100 parts H_2SO_4 and 50 parts HNO_3), the mixture then being maintained at 26–30° C. for 6 hours. The upper layer (mono-nitrotoluene + gasoline) was separated from the acid, washed with water, alkali, water, dehydrated and finally filtered. Gasoline was removed by distillation, traces of residual high boiling hydrocarbons being removed by heating at 60–70° C. and 5–10 mm. for 1·5 hours. The yield of mono-nitrotoluene was 91% of the theoretical. To prepare the di-nitrotoluene, the toluene fraction was nitrated by using firstly, 45 parts HNO_3 and secondly 55 parts of H_2SO_4, the yield being 91% of the theoretical. The crude di-nitrotoluene was purified by recrystalisation with alcohol (yield 80%, m. pt. 70° C., N_2 content 15·06%). It is concluded that 570,000 kg. of mono-nitrotoluene per annum could be obtained from the 100 koku of the present daily production of Shukoko crude. W. H. T.

657. Higher Aliphatic Compounds. III. Preparation of Paraffins. P. C. Carey and J. C. Smith. *J.C.S.*, 1933, 346–347.—Three methods for the preparation of paraffins are described. They are stated to give good yields of the pure products.

The first method involves solution of, *e.g.*, cetyl iodide in acetic acid, and addition of zinc dust in three portions during 3 hours. The liquid is decanted from zinc dust and cetane precipitated by ice-water.

In the second method the iodide is refluxed with alcohol and zinc-copper couple. The third method is by reduction of the iodide with activated palladium-calcium carbonate catalyst and hydrogen, in the presence of potassium hydroxide and propyl alcohol. E. B. E.

658. Isolation of a Cancer-Producing Hydrocarbon from Coal Tar. Parts I., II., and III. J. W. Cook, C. L. Hewett and I. Hieger. *J.C.S.*, 1933, 395–405.—It was observed that certain tars and mineral oils which produce cancer of the skin possessed a common specific fluorescence spectrum. The method is described by which certain fractions and ultimately the hydrocarbon 1 : 2-benzpyrene were isolated from a soft pitch—all of which were carcinogenic to a much greater degree than the original pitch, and in each case gave the fluorescence spectrum with bands at 4000, 4180 and 4400Å.

4 : 5 benzpyrene and 1 : 2 benzanthracene were also isolated, the latter from coal tar. Neither of these compounds had much cancer-producing action, but 1 : 2 benzathracene is the parent substance of a considerable group of carcinogenic hydrocarbons.

The identities of 1 : 2 and 4 : 5 benzpyrenes were established by comparing with synthetic compounds. It was found that the former was present in the pitch in an amount not less than 0·003%. C. C.

659. Apparatus and Methods for Precise Fractional Distillation Analysis. II. and III. W. J. Podbielniak. *Ind. Eng. Chem., Anal.*, 1933, **5**, 119–141. II. *Laboratory Columns for Precise and Rapid Fractionation of Gases and Liquid Samples.*—If in the analysis of a more or less complex sample the separation by fractionation is sharp enough to result in perfectly horizontal plateaus for the pure components of the sample, then the amount of the intermediate mixed fraction, indicated by the fractional distillation curve, is a very definite and useful criterion of the performance of the column employed. Thus, the smaller the intermediate fraction the more accurate is the analysis. The size of the intermediate fraction per cent. is a function of, and is completely determined by the following factors: (1) Composition and distilling characteristics of sample and of the vapour entering the column; (2) total time of distillation; (3) regulation of (*a*) distillation rate, (*b*) reflux ratio, (*c*) distillation pressure; (4) ratio of ten times the hold-up of material in the fractionating section (excluding reflux or condenser) to maximum column capacity; (5) ratio of ten times the hold-up of material in reflux or condenser section to maximum column capacity; (6) scrubbing effectiveness of column packing; (7) efficiency of thermal insulation of column; (8) general design and construction of fractionating column and apparatus.

Factor 1.—For ideal solutions the amount of the intermediate fraction is approximately inversely proportional to the difference in boiling points of the two components separated. The lower the average molecular weight of a mixture the more amenable it is to separation by fractional distillation; thus, with increasing molecular weight the difference in boiling point between successive normal hydrocarbons decreases and the number of isomers present increases considerably.

Factor 2.—The more effective the fractionating columns, the shorter will be the total time of distillation to secure the desired results. The amount of hold-up of material in the reflux or condensing section of the column is frequently a controlling factor of the total time of distillation.

Factor 3.—It has been found in this instance that best fractionation can be obtained by regulating the heat to still and reflux cooling so that the packing of the column is barely wet. Also, the reflux ratio should be inversely proportional to the tangent of the fractional distillation curve. For precise fractionation it is essential to have precise and practically lagless control of heat supply to still, reflux cooling, etc.

Factors 4 *and* 5.—These were determined on nine distilling tubes with several different types of packing (single wire coil, double wire coil, helical flat strip, jack chain and glass cylinder). The experimental determination

of hold-up of liquid was made by pouring 10 c.c. of toluene into the vertical distilling tube and measuring the liquid drained off after 1 minute. The hold-up of material in vapour was computed from the dimensions of the distilling tube and a factor of 1/225 was used to convert vapour to liquid. The determination of maximum distilling capacity was effected in the following manner: Toluene was poured into the top of the column at a constant rate and simultaneously air is blown into the bottom of the distilling tube at a steadily increasing rate until the column just begins to flood. From several experiments a curve can be plotted of quantity of toluene per minute against the ratio of quantity of toluene per minute over quantity of air per minute —and from this can be derived the maximum vapour capacity of the distilling tube under examination.

Factor 6.—Scrubbing effectiveness of column packings can be determined by pouring a standard wash liquid into the top of the column at a measured rate in counter-current relation with a suitable standard vapour entered into the bottom of the column at a constant rate 225 times greater than that of the standard wash liquid rate. By the analysis of the enriched wash liquid and the stripped vapour it is possible to determine quantitatively the above property of the column and its packing, free from the effect of hold-up.

Factor 7.—Various types of insulation are here discussed. The strip silvered vacuum jacket is fairly successful for low temperature fractionations, even down to liquid air temperatures. For high temperature distillation above 100° and up to 300° C., this type of vacuum jacket becomes inadequate. Various experiments were carried out with the packed type of vacuum container, but it was found that a reflector partition vacuum tube, made by putting thin polished partitions spread apart from the glass walls in the vacuum tubes, were superior and effective in insulating efficiency. Results of experiments demonstrate that for distillations at temperatures above 150° C. a double perforated reflector becomes desirable. To overcome the differential expansion of the inner and outer tubes of the fractionating column thus constructed it was found necessary to make the inner tube of transparent fused quartz, while the rest of the jacket was made of pyrex.

III. *Apparatus for Precise High Temperature Fractionation of Complex Liquid Mixtures.*—A detailed description and diagrams are given of a complete fractionating unit for use with complex liquid mixtures at reflux temperatures ranging from —190° to +300° C., and at distillation pressures ranging from 1000 to 1 mm. Hg. absolute. Reflux cooling is regulated by turning a fine needle valve controlling compressed air supply. The reflux temperature is measured by a single function fine wire thermocouple in conjunction with a millivoltmeter or potentiometer. Distillate volumes are measured in long, finely-graduated burets. The fractionating column is jacketed with a double-metal-reflector sleeve-type vacuum jacket with a nichrome strip heater interposed between it and the column. The joint between distilling flask, of capacity from 50 to 3000c.c., according to requirements, and tube is made by a well-fitted cork sealed with Le Pages glue. The still heater is of the radiant electric type. By the use of vacuum distillation components of boiling points up to 500° C. may be fractionally distilled, but owing to considerable decrease of the capacity of the distilling tube, a proportionately larger diameter tube is used for vacuum work. Several practical examples are given to demonstrate the high fractionating effectiveness, precision of reflux temperature and distillate measurement. It is claimed that the apparatus is especially suitable for routine analysis of petroleum products. R. E. D.

660. Loading Combustion Tube in Carbon and Hydrogen Determination on Liquids. J. R. Bailey. *Ind. Eng. Chem., Anal.*, 1933, **5**, 171.—The method described and employed in research on petroleum bases consists of the direct introduction of the sample into the combustion tube from a pipet. The combustion tube, after removing a layer of copper oxide, is secured in a vertical position and by means of a standard weighing pipet and a removable clamp, the sample is introduced and descends drop by drop to the permanent layer of copper oxide, without impinging on the sides of the combustion tube. This procedure ensures complete combustion. R. E. D.

661. Conradson Coke Test for Engine Oils. C. Ehlers and W. Hoepfner. *Petr. Z.*, 10.5.33, **29** (19); *Motorenbetrieb*, **6** (5), 1–4.—This test was carried out on various blends of Russian oil with Western bright stock and Pennsylvanian oils before and after use, using Summer and Runge's Meker burner. The results were classified into four types: (1) First-class; (2) good; (3) normal; and (4) inferior oils, according to the viscosity values in degrees E at 50° C. The values for the Conradson coke were greater for used oils than the original oils and they increased with the driving distance. Actually, the coke was formed due to incomplete oxidation in the motor. Generally non-viscous machine oils gave lower Conradson values than very viscous oils; also, the values increased with increase in viscosity for a series of oils derived from the same crude oil. Increased refining was found to decrease the coke value. W. S. E. C.

662. Micro-Fractionating Column for Liquids Having a Low Heat of Vaporisation. P. E. Weston. *Ind. Eng. Chem., Anal.*, 1933, **5**, 179.—The column described was designed primarily for the analysis of butenes. It is of the Vigreaux type, made by heating small spots on the tube and indenting them with a wire. The upper end of the column is expanded into a bulb, into which is sealed a tube cut diagonally to a point to permit observation of the reflux. The whole column is vacuum-jacketed and can be heated electrically. All the vapour is condensed and by means of a capillary stopcock some of it is withdrawn into the receiver whilst the remainder runs down the column. 10 to 15 c.c. of the sample can be readily analysed in this manner, but it is important that a reflux ratio of at least 4 be maintained. Distillation curves of the separation of aniline and nitrobenzene, and of 1 chlorobutene and 2 chlorobutane are given. R. E. D.

663. An Improved Head for Laboratory Fractionating Columns. E. C. Wagner and J. K. Simons. *Ind. Eng. Chem., Anal.*, 1933, **5**, 183.—The still head described is made entirely of glass and is fitted to the column by means of a ground glass seat. It incorporates the desirable features of variable reflux up to total reflux, determination and control of the reflux ratio, accurate observation of the boiling point, and cool condensation of the material investigated. In outline, the apparatus consists of a partial condenser yielding primary reflux which protrudes into the vapour stream. Residual vapour then passes on to the thermometer and is eventually condensed by a spiral condenser, whilst an addition condenser reduces the temperature of condensate. Connection is made between the condensate arm of the last condenser and the main vapour stream just above the primary reflux condenser. By means of a stopcock interposed here, reflux may be increased at will. The reflux ratio is readily ascertained by counting the drops from outlet tube to the final condenser and those dropping back into the column from the base of the still head. R. E. D.

664. Constant Temperature Apparatus. S. Kambara and M. Matsui. *J. Soc. Chem. Ind. Japan*, 1933, **36**, 134B.—The bath consists of a copper tank (31 cm. by 3·3 cm.) surrounded by a cylindrical glass jacket containing ethyl alcohol which acts as temperature regulator. The jacket is electrically wound, the current being controlled by a vacuum tube and relay. The jacket is housed in a copper can which in its turn is placed in a large Dewar vessel (40 cm. by 15·5 cm.) set in an outer copper sheath, the whole being contained in a wooden box. According to the temperature required, the outer space is filled with ice, cold brine or air, the intermediate annulus with solid carbon dioxide and methyl alcohol, and the inner copper can with methyl alcohol. In operation, the bath is cooled to the desired temperature with the thermostat open to the atmosphere and using a stirrer in the alcohol, after which the current is connected to the controlling relay and valve.

W. H. T.

665. French Standardised Methods for Testing Oils and Greases. *Revue de Metrologie Pratique*, 1933, **11**, 9–22.—The "Afnor" has published for consideration, three papers on physical properties of oils, namely, on density, viscosity and dropping-point. The two latter are given in this article.

It is recommended that viscosity be expressed in absolute units. Different types of absolute, relative and commercial viscometers are mentioned, with remarks on their calibration.

Dropping-points of greases, etc., are determined with the Ubbelohde apparatus. A glass cup is permissible in general use, but in cases of dispute a metal cup must be used.

E. B. E.

666. Experiments on Antioxidants. T. Yamada. *J. Soc. Chem. Ind. Japan*, 1933, **36**, 176B.—The effects of α-naphthol, β-naphthol, hydroquinone, α-naphthylamine and p-amidophenol as anti-oxidants for switch oils have been examined by a manometric oxigen absorption test at 100° C. It is shown that the effect of anti-oxidants is nullified by copper and other substances, such as peroxides, alcohols and acids. It was also observed that oils which absorb oxygen the fastest are those with high peroxide contents. All the anti-oxidants examined, with the exception of hydroquinone, reduce the peroxide to some extent within a few hours, but the rate of reduction is relatively slow.

W. H. T.

667. New Processes for Examination of Bitumen and Bitumen-Containing Mixtures. Part I. J. Greutert, *Bitumen*, 1933, **3**, 49–52.—This is a summary of methods tried out in the N. V. de Bataafsche Maatschappij laboratories. For the extraction of bitumen from mineral mixtures, cold extraction with dried carbon disulphide plus 5% absolute alcohol is recommended. Satisfactory recovery of the bitumen is difficult. The author prefers a modification of the method due to Suida (*Asphalt u. Teer*, 1931, 197). Full details are given with a diagram of the apparatus. To obtain good results considerable care is required in controlling the oil bath temperature and adjusting the stream of carbon dioxide so that at first the solution temperature does not rise above 25° C. A chart gives the scheme of heating for the oil bath and for the solution itself. 600 ml. of solution are distilled over in about 50 minutes. The recovered bitumen is slightly changed—the penetration is from 0 to 7% lower, while the softening point (B. & R.) may be raised up to 2%.

To separate bitumen from an emulsion, 200 ml. of the latter are added to a mixture of carbon disulphide (800 ml.), acetone (200 ml.) and ethyl alcohol (200 ml.). The bitumen solution is washed, filtered over calcium chloride and the bitumen recovered by the above method. With stable emulsions a small amount of ammonia accelerates coagulation. Clay-stabilised emulsions, after addition to the above mixture, are centrifuged.

Viscosities from 0·8 to 10,000 poises and above are measured by the Saal spindle viscometer, which is described and illustrated. The time taken by a heavy spindle to sink to a definite depth in the liquid under examination contained in a cylinder of specified dimensions is measured. The velocity of the spindle is given by

$$v = \frac{(d_2 - d_1)g}{6\,\eta\,R} \cdot x_0^3$$

where $(d_2 - d_1)$ is the difference between the specific gravity of the spindle and the fluid, η the viscosity in poises, R the radius of the spindle and x_0 the distance between the wall of the cylinder and the spindle in cm. The apparatus is standardised with a lubricating oil (viscosity about 50 poises) and a factor then converts the time to viscosity. C. C.

668. Spreading of Water on Asphaltic Bitumen and Tar. F. J. Nellensteyn and N. M. Roodenburg. *Koll. Z.* 1933, **63** (3), 339–347.—The application of Antonow's law to systems asphaltic bitumen-water and tar-water is discussed. The law is expressed by the equation $\sigma f_1 g = \cdot\sigma f_2 g + \cdot\sigma f_1 f_2$, where $\sigma f_1 g$ is the surface tension of the lower liquid (asphaltic bitumen), $\sigma f_2 g$ is that of the upper liquid (water), and $\sigma f_1 f_2$ is that of the two liquids (asphaltic bitumen-water). The law is applied and confirmed practically for the media named and by means of this law the border angle of a drop of water falling on a bitumen is calculated for temperatures between 0° and 100° C. W. S. E. C.

669. Characteristics of Liquid Asphaltic Materials. P. Hubbard. *Contrac. J.*, 1933, **108** (2809, 2810), 1056, 1123–1124.—Owing to ease of application and low cost of liquid asphaltic road materials, they are increasingly used in place of asphalt cements; these liquid asphalts are asphalt cements held in solution by oily bodies, and their characteristics depend on the type and quantity of oily bodies present. Materials which remain liquid when used in road construction are classified as slow-curing in contrast with cut-back asphalts, which are obtained by dissolving asphalt in volatile distillates which evaporate and leave a semi-solid asphalt. Cut-back asphalts are classified as rapid or medium-curing, depending on rate of evaporation of the solvent.

All liquid asphalts are manufactured in a number of grades of varying viscosity. Tests applied to these materials are viscosity, distillation, penetration or float test of distillation residue. In rapid-curing products at least 50% of the total distillate passes off at 347° F., and the residue above 680° F. usually has a penetration of 60–120. Medium-curing products have little distillate up to 347° F. and the residue above 680° F. usually has a penetration of 100–300. When heated to 680° F., slow-curing products may sometimes yield an appreciable amount of distillate, but the residue is liquid, although for purposes other than dust palliation it should have a float test of at least 25 seconds at 122° F. The viscosity of liquid asphalts should be as high as is consistent with ease of application. In addition to loss of solvent, curing is sometimes effected by means of selective adsorption and absorption, when the aggregate contains an appreciable quantity of material passing a 200 mesh sieve or if the structure of the particles is porous.

Rapid-curing products are best suited for use with clean mineral aggregates free from 200 mesh particles, for seal coating, for thin bituminous carpets and for cold patch mixtures. Mixtures should be allowed to dry out throughly before compression. Medium-curing products of low viscosity are suitable for dense, fine-grained surfaces, but for the preparation of mixtures with gravel or broken stone, containing relatively large amounts of 200 mesh

particles, a high viscosity is essential. Slow-curing products of low viscosity are excellent dust palliatives, and high viscosity materials have been extensively used in road-mix and cold-laid plant mix with gravel and broken stone, containing 7–14% of 200 mesh particles. A. O.

670. Determination of Asphaltic Bitumen in Mixtures with Tar. (See Abstr. No. 671.) H. Mallison. *Roads and Road Constr.*, 1933, **11**, 165.—The author found the dimethyl sulphate test for bitumen in tar mixtures unsatisfactory and devised a test based on that of Marcusson (*Die natürlichen und künstlichen Asphalt*, 1921—106) which has been adopted as the German Standard (DIN 1995-1996).

3–4 grams of mixture are refluxed with ten times its weight of chloroform or carbon disulphide, filtered, the filtrate evaporated and the residue heated on a steam bath for ½ hour with 6–8 mls. of concentrated sulphuric acid. The mixture is cooled, diluted with 500 mls. water, and after standing for 2 hours is decanted on to a weighed filter paper, washed free from acid, dried and weighed. Satisfactory results are obtained with mixtures containing up to 30% of bitumen of the Mexican type; but certain Galician and Esthonian bitumens and the bitumen from Trinidad asphalt give values which are too low. A. O.

671. Estimation of Bitumen in Tar Mixtures. G. P. Storer. *Roads and Road Constr.*, 1933, **11** (124), 134.—When a test was required for the estimation of the bitumen in tar-bitumen mixtures, the only method available was one in which the distillate between 275–350° C. is shaken with dimethyl sulphate, the mixture allowed to settle and the volume of oil separating noted. Experiments with tar and tar-bitumen mixtures indicated that the method was satisfactory, but after being used as a routine test for a time a negative result was obtained on a tar-bitumen mixture. Examination of the tars and the bitumen showed that the test was merely one for paraffins and not for bitumen, the bitumen actually giving a negative result, while tars from vertical retorts, which often contain paraffins, gave positive tests. A. O.

672. Classification of Bituminous Materials. Proposed Specification DIN, DVM 4301. *Erdol u. Teer*, 1933, **9**, 237–8; *Asphalt u. Teer*, 1933, **33**, 353–354.—Bituminous materials are divided into three main classes: (1) Soluble in carbon disulphide and mainly saponifiable, *e.g.*, montan wax, etc.; (2) soluble in carbon disulphide and mainly unsaponifiable (this group is sub-divided into: (*a*) Ozokerite, etc.; (*b*) petroleum and petroleum distillation residues; (*c*) the carbon disulphide soluble portion of asphaltites, natural asphalt, etc.); (3) insoluble in carbon disulphide and mainly unsaponifiable, *e.g.*, brown coal, etc.

Related materials include the two groups, tars and pitches, and the refinery residues obtained by the chemical treatment of certain of the above materials, including acidic resins of various kinds.

Reference is made to the scheme suggested by H. Mallison (Teer, Pech, Bitumen und Asphalt, 1926) and also to the definitions in the Technical Dictionary of Road Terms in Six Languages issued in 1931 by the International Association of Road Congresses.

A simple definition is suggested for asphalt—a natural or artificial mixture of bitumen with mineral material—the bitumen being a petroleum distillation residue or that portion of natural asphalt or asphaltic rock which is soluble in carbon disulphide. C. C.

673. Direct Iodination of Monosubstituted Acetylenes. T. H. Vaughn and J. A. Nieuwland. *J.A.C.S.*, 1933, **55**, 2150–2153.—It has been found that a solution of iodine in liquid ammonia will directly iodinate acetylenes, giving a mono-iodide and ammonium iodide. Phenyl, tolyl and vinyl acetylenes react readily at –34° C., giving almost theoretical yields, whereas the simple alkyl acetylenes do not react so readily at this temperature, but give 15–45% yields at 25° C. The sodium compound of amylacetylene is readily iodinated. At normal temperatures (in an autoclave) iodine reacts completely with liquid ammonia giving ammonium iodide and nitrogen.
E. B. E.

674. Production of Cancer by Pure Hydrocarbons. Part I.: J. W. Cook, I. Hieger, E. L. Kennaway and W. V. Mayneord. Part II.: J. W. Cook. *Proc. Roy. Soc.*, 1932, B **111**.—Tests for cancer-producing action have been carried out on a number of polycyclic aromatic hydrocarbons composed entirely of benzene rings. Only 1:2:5:6-dibenzanthracene and some closely related compounds were found to be carcinogenic. The former retains its activity when highly purified and has been shown to be active in 9 different media, producing cancer of the skin when applied in a concentration of 0.003% in benzene. Further work has shown 6-*iso* propyl -1:2 benzanthracene to be carcinogenic, and certain compounds containing the 1:2:5:6 dibenzanthracene ring system have produced tumours. These compounds were the 2-methyl, 3-methyl, 9-amino, 9-methoxy and 9:10-dibenzyl derivatives and phenanthra-acenaphthene. In all cases, the activity was less than that of 1:2:5:6-dibenzanthracene, but the allied compound 5:6-*cyclo* penteno-1:2-benzanthracene proved more active than any of these. There is evidence that a molecular structure consisting of new rings attached to the 1:2 and 5:6 positions of the anthracene ring system is particularly effective in promoting carcinogenic activity. W. H. T.

675. Patents on Analysis and Testing. Mono Ges. E.P. 392,881, 25.5.33.—A device for gas analysis by the combustion of the gas in a mixture containing oxygen. The apparatus consists of two combustion chambers spaced separately in a furnace through which chambers the gas mixture successively passes. The first is provided with catalytic agent (palladium asbestos) and the second with a filling of a metallic oxide yielding oxygen (copper oxide) W. H. T.

Class 600. Refining and Refineries.

676. Cracking of Gas Oil in the Liquid Phase under Atmospheric Pressure in Contact with Catalysts. V. Ivanyss. *Petr. Z.*, 17.5.33 and 24.5.33, **29** (20) 1–5 and (21) 1–6.—Experiments are described in which gas oil from Grosny crude oil was cracked with and without catalysts in a special distillation apparatus fitted with a dephlegmator. Cracking was carried out at atmospheric pressure and under the influence of various metals, oxides, hydroxides, carbonates, chlorides, Kieselguhr, activated charcoal and floridin as catalysts. For each experiment 1 kgm. of gas oil was used with 10% of catalyst and every 5 min. readings were taken of the temperature of the liquid to be cracked, of the vapour, quantity of distillate and gas formed. The heating was slow at the commencement of the reaction and then the temperature was increased to 324–327° for 3 hours in most cases. The specific gravity, iodine value, Engler distillation, volume of distillate and residue were calculated on the original substance.

The results showed that the shortest time for cracking was 4–5 mins., at a maximum temperature of 300° except for aluminium chloride which required 295 mins. for heating up.

Reflux from the dephlegmator caused a decrease in the yield of the light boiling products, *e.g.*, benzine. A slow increase in temperature in conjunction with a removal of cracked products gave the maximum yield of light boiling products, these being formed during the first 40–50 mins.

A greater yield of distillate was obtained with catalysts than without, and it was generally observed that metals were the weakest catalysts, nickel and iron developing the greatest quantities of gas while chlorides were found to be most effective as catalysts.

A number of graphs are given showing the relationship between quantity of distillate in ccms. and the temperature in ° C. These show that for metallic catalysts, distillate formed slowly with increase in temperature the limiting point being 295–297°. Below this temperature a greater quantity of distillate was formed under the influence of metals than without catalysts and inversely, the volume of distillate formed at higher temperatures is less in the presence of these catalysts than without them. Metallic sodium gave a large yield of tarry residue. The limiting temperature for the oxides was 300°, for the chlorides of calcium and zinc 300°, for chlorides of magnesium and iron 205° or 191°, whereas caustic soda, sodium and potassium carbonates, graphite and activated charcoal had a very slight influence on the reaction. Caustic soda (100 gms.) mixed with zinc (50 gms.) had an effect similar to zinc, aluminium chloride mixed with iron powder or tin was similar in effect to the chloride alone except that the temperature of distillation was lower.

Aluminium chloride was found to be the best catalyst when used in an amount equivalent to 10% of the gas oil used. The yield of light boiling constituents amounted to 74·26 or 50·96%, Sachanen and Tilicheyev obtained 38·4%, the former being greater than the latest Roumanian pressure distillation process. The distillate obtained with aluminium chloride is colourless and needs no refining, and the residue obtained after cracking for 3 hrs. under the conditions specified is a porous coke. W. S. E. C.

677. Remodelling and Modernisation of Holmes-Manley Cracking Equipment. C. M. Johnson. *Refiner*, 1933, **12**, 203–206.—A description, illustrated by flow sheets, of the development of a Holmes-Manley cracking unit used primarily for cracking gas oil and other clean overhead stocks, to meet increasing demands both as to quality and yield of product, culminating in a functional combination of crude topping, viscosity breaking of the topped crude and cracking. B. C. A.

678. Process for Emulsifying Mineral Oils. A. Salmony. *Matt. Grasses*, 15.3.33 (299), 9785–6.—A new product "Emulgator" is described, which enables the preparation of mineral oil emulsions in a state of great stability and in a very easy and simple manner. The melting point of the product is 35–40° C. S. T. M.

679. Application of Inhibitors to Cracked Gasolines. G. Egloff, J. C. Morrell, C. D. Lowry and C. G. Dryer. *Oil & Gas J.*, 30.3.33, **31** (45), 64.—A series of tests have been carried out using Universal inhibitor in order to examine its effect on the gum content, colour stability, gum stability and octane rating of samples of treated and untreated cracked gasolines before and after storage. Adding 0·05% of the inhibitor to an untreated Pennsylvanian cracked gasoline reduced the gum content (copper dish test) from 259 mgms. per 100 ml. to 19 mgms., whereas treatment with Fuller's earth only effected a reduction to 29 mgms. The gum and octane rating stabilities of the

inhibited untreated cracked gasoline were better than those of the earth treated material over a period of seven months' storage. Other test results indicate that the efficiency of the inhibitor, as far as initial gum content and induction period are concerned, is not affected by doctor or soda treatment, provided these processes are carried out before addition of the inhibitor. The efficiency is also unaffected by the addition of dye or of T.E.L. Addition of 0·05% of inhibitor to an untreated mid-Continent gasoline distillate obtained directly from the cracking unit reduced the gum content from 426 mgms. to 11 mgms. per 100 ml., and increased the induction period from 260 to 630 min. This enabled the processes of acid treatment and re-running of a pressure distillate with subsequent sweetening of the gasoline to be eliminated.

Tests carried out over a period of 6 months show that the addition of 0·01% of the inhibitor also improved the gum and octane rating stabilities of a number of gasolines treated with acid or Fuller's earth and reduced their initial gum contents. With certain gasolines some chemical treatment is necessary—*e.g.*, on account of colour or sulphur content—but the use of an inhibitor may effect economies by making possible a milder treatment than would otherwise be necessary.

Besides possessing the properties already mentioned an inhibitor for commercial use should: (1) Exhibit ready solubility in gasoline but low solubility in water. (2) Not impart colour to gasoline but prevent colour deterioration. (3) Be sufficiently volatile to vaporise with the gasoline and preferably be a liquid. The inhibitor mentioned fulfils these requirements and is being used in many refineries at the present time. R. A. E.

680. Refining of Playa Del Rey Crude Oil. By O. C. Smith and H. J. Spangler. *Oil & Gas J.*, 30.3.33, **31** (45), 75.—Crude from the Playa Del Rey or Venice Field of California has the following properties: grav. A.P.I. 24·2°, Ichthyol content nil, nitrogen 0·52%, aromatics 3·47%, sulphur 2·23%. The products obtainable on distillation are: gasoline of 410° F.E.P. 25%, kerosine distillate of 500° F. E.P. 4%, gasoil 3·5%, and fuel oil having a visc. S.F. at 122° F. of 219 secs., 66·1%. The sulphur content is very high for a light crude, and presents a problem in refining since practically no H_2S is present and very little is formed during distillation. The sulphur contents of the untreated products are: gasoline 0·43%, kerosine 0·62%, gas oil 1·5%, fuel oil 2·85%. In an endeavour to find a satisfactory method of reducing the sulphur content of the products to meet market requirements a number of tests have been carried out in laboratory stills of about 2 gal. capacity, the oil being distilled in the presence of various treating agents. Caustic soda in a solution of 40° Bé., aluminium chloride, lime, cuprous oxide, soda ash, potassium bichromate and permanganate were used, and in one experiment air blowing of the crude during distillation was tried. The gasoline fraction from each test was subsequently treated with soda, washed with acid and then neutralised. The only reagents which effected appreciable reductions in the sulphur contents of the gasoline and fuel were soda solution and aluminium chloride, whilst potassium bichromate and permanganate reduced the sulphur content of the gasoline but not that of the fuel. The reagents, however, had the effect of increasing the ash content of the fuel to 0·30/1·6%, whilst in no case was the sulphur content of the gasoline reduced below 0·09%. Straight run gasoline from untreated crude was therefore treated with soda, then with 10 lb. of acid per brl. in 5 washes, and neutralized. The sulphur content was reduced to 0·096%. Treating tops with soda, followed by 10 lb. acid per brl. in 3 washes, neutralization and redistillation yielded a gasoline containing 0·08% sulphur.

Kerosine distillate has been treated commercially with 10·83 lb. of 66° Bé. acid, 27·32 lb. of fuming acid and 0·04 lb. of 2° Be caustic soda solution per brl. This treatment reduced the sulphur content from 0·62% to 0·086%. The treating loss was 12·15%, but the colour and burning properties of the refined oil were good. It was noticed that when distilling crude some H_2S was evolved at a temperature of 590° F., so a quantity of topped crude was cracked in a bomb. The temperature was raised slowly to 785° F. and held there for 20 minutes. A pressure of 700 lb. per sq. in. was recorded. The bomb was then allowed to cool and the synthetic crude obtained was examined. The topped crude contained 2·77% sulphur, the synthetic crude 2·39%, tops from synthetic crude at 500° F. 2·31% and residuum 1·89%. The tops from synthetic crude distilling over at 500° F. amounted to 8·7%, and on re-running yielded 4·1% of gasoline with a sulphur content of 2·68%. The gasoline after doctor treatment, acid treatment with 15 lb. per brl. of 66° Be acid and neutralization still contained 1·30% sulphur. Cracking therefore yielded a fuel of reduced sulphur content, but a gasoline very rich in sulphur.

R. A. E.

681. Action of Carlonit. R. Fussteig. *Matt. Grasses*, 15.2.33 (298), 9752–54. —The author has met with considerable success by employing a natural earth from Carlsbad ("Carlonit") for the preliminary decolorisation of lubricants and paraffin. He has found that this cheap "Carlonit" can replace activated earths and obtained good neutralisation of suspended acid tars (formed by acid treatment). The author classifies earths by the following considerations: I., Decolorising Power; II., Power of Absorption; III., Filtration Capacity; IV., Reaction.

Carlonit is a hydrosilicate of aluminium and magnesium obtained from the volcanic region of the warm springs at Carlsbad. It has the following analysis: SiO_2, 45·68%; Al_2O_3, 23·05%; Fe_2O_3, 6·50%; TiO_2, 2·55%; CaO, 3·53%; MgO, 2·41%; K_2O and Na_2O, 2·88%; loss on calcination 13·40%. It is basic in character.

The following examples are given for the use of Carlonit after acid treatment of the specified products. A. Paraffin is mixed with 0·5% of Carlonit for 30 minutes until the acid odour is destroyed. 1·8% of Saxonit is then added, the mixing continued for 1 hour, and the mixture then filtered. B. The acid treated lubricant is mixed with 1% of Carlonit as above at 80° C. 1·5% of Saxonit is then added as above.

Good results are claimed for the treatment of cracked spirits. S. T. M.

682. Brucite Treatment of Light Oil Distillates. E. C. Higgins. *Nat. Petr. News*, 12.4.33, **25** (15), 26–31.—The sweetening of gasolines by various reagents is due to the conversion of mercaptans into dialkyl disulphides, or to the complete removal of those bodies. The doctor test is discussed chiefly from an economic standpoint. The use of a new reagent, magnesium hydroxide or Brucite, is described. While the mineral is available it has been found advantageous to calcine magnesite and produce the hydroxide from the resulting MgO. The mechanism of the reaction is similar to that of litharge. $Mg(OH)_2$ reacts with mercaptans to produce magnesium mercaptides, which in the presence of added sulphur form dialkyl disulphides and magnesium sulphide. The reagent is broken to 3/8 in. mesh, packed into a tower, and is supported on a 100–200 mesh Monel metal screen. The magnesium sulphide formed is deposited in a film on the particles of Brucite as the gasoline is passed through it. This renders periodic revivication necessary. This is effected by filling the tower with water and passing steam through the coils with which each tower is equipped. The mass is boiled for 3 hours and the liquid is drained off. The tower is then filled with 5° Bé.

caustic soda and boiled for another 3 hours. Two hot water washes follow and the Brucite is partially dried by the coils. Half the water is removed in 6 hours, and the drying is completed by passing air at 335° F. through the tower. The reagent is thereby completely recovered in about 24 hours. It is claimed that the new process is cheaper than the litharge process, that washing and settling are obviated. The Brucite refined product is stated to be sweet, non-corrosive to copper strip, sunlight stability and all types of gum unchanged, although in some cases of high mercaptan gasolines a marked reduction of potential gum was obtained. H. G.

683. Principles of Rectification. G. A. Burrell and N. C. Turner. *Nat. Petr. News*, 22.3.33, **25** (12), 26; 19.4.33, **25** (16), 25.—The paper opens with a short account of the progress of rectification from the Coffey Still used in 1831 for increasing the concentration of alcoholic liquor, to the recent developments in fractionating columns applied to the petroleum industry.

The fundamental requirements in rectification and the rules governing the operation of a column are stated, and a discussion of the relative merits of packed and bubble towers follows. It appears that the packed tower is the more efficient and economic up to a diameter of 20 in.

The main body of the paper deals with the practical and theoretical problems arising from the stabilisation of pressure distillate. This is treated in order to remove methane, ethane, propane and sufficient butane to ensure that the stabilised product will have a Reid Vapour Pressure of 10 lb./sq. in. at 100° F. The estimation of the amount of light products to be removed is based on the law of partial pressures.

The temperature and pressure under which rectification is to proceed is next determined. The pressure is fixed by the vapour pressure of the overhead product at the temperature of the condenser, while the temperature is that necessary to bring the stabilised P.D. at the bottom of the column to a vapour pressure equal to this working pressure. The diameter of the tower is fixed by the quantity, temperature and pressure of the vapour to be handled, and can be easily determined once the throughput and reflux conditions are known. Plate thickness is calculated without difficulty, an allowance being made for corrosion.

It has been found that the amount of reflux required for a given degree of separation decreases as the number of plates increases. There is, however, an economic limit to the number of plates employed. In ordinary cases twice the minimum calculated reflux ratio is used, and this is based on the propane content of the P.D., the relationship being given by a simple equation.

To determine the approximate number of plates required, the composition of the mixture at each descending plate is calculated until a condition is reached where the mixture has a composition approaching that of the feed.

The necessary condenser and reboiler areas are easily arrived at, given a knowledge of the specific heats of the mixture components, and the paper concludes with a statement of the balance of heat involved in the whole process. D. S.

684. Continuous Clay Method of Treating Gasolines. C. O. Willson. *Oil & Gas J.*, 30.3.33, **31** (45), 61.—A continuous clay treatment for cracked gasoline is being used by one company at five of its Canadian refineries. The pressure distillates from which the finished gasolines are refined are obtained from cracking plants of the Tube and Tank type, but the charging stocks vary widely in properties, necessitating variation in treatment required to obtain a uniform product. Advantages claimed are: (1) an improvement in initial colour and in colour stability, as compared with acid treatment of pressure distillate, followed by distillation with fire and steam; and (2)

reduction in loss to 1/10th. At Sarnia, the pressure distillate is first lye washed to remove H_2S, and after preheating in a vapour heat exchanger, a partial condenser and a bottoms heat exchanger, passes into a nine-plate tower near the bottom and finally to a still in which the liquid temperature is held at about 150° F. higher than the vapour temperature at the top of the fractionating tower. This ensures complete stripping of gasoline fractions without production of heavy ends, which require more clay for colour stabilization. From the top of the column the vapours enter a specially converted bubble tower at a point below the bottom plate. This tower is fitted with 15 plates containing 114 bell caps per plate. The plates are spaced 2 ft. apart, with the top plate about 6 ft. below the top of the tower in order to permit entrained clay and carrier oil to settle out of the vapour. A fine clay (99% through 100 mesh) is mixed with a finished naphtha and maintained in uniform suspension in a paddle mixer, so that 24 gallons of liquid contain 350 lb. of clay. This mixture is pumped to the top of the plate of the bubble tower, and works down the tower from plate to plate so that the untreated vapours entering the bottom of the tower are contacted with progressively fresher clay during their upward travel to the top of the tower. The vapours from the top of the tower are passed through a condenser and then pumped to finished gasoline storage. The mixture of clay, carrier oil and polymers from the bottom of the tower is conducted to the top of a cone bottom settling tank, where it passes over a series of baffle plates in the upper cylindrical portion of the tank. Oil, free from all but the finest particles of clay, is withdrawn, and is further settled in an auxiliary tank before being returned to the still. Below the conical settling tank is a vacuum pan, the bottom of which is held in place by bolts so that it can be raised or lowered by special plant when required. This bottom supports a cylindrical basket made of wire cloth. Clay from the conical tank is periodically dropped into this basket, and when the latter is full, bottoms from the still are circulated through a coil in the basket, vacuum applied and the oil in the clay distilled off. When the clay is thoroughly dry, the vacuum is broken, the basket of clay lowered, picked up by a hoist and discharged into the spent clay hopper. By noting the rate of discharge into the conical settling tank the operator can tell when the clay tower is plugged and arrange for distillate to be pumped to the top of the bubble tower instead of clay mixture, in order to flush the plates. The colour of the treated gasoline is checked periodically, and the clay mixing tank gauged frequently to check the usage. Clay consumption averages 3·5 lb. per brl. of finished gasoline of 410° F. E.P. A smaller quantity could be used as far as gum formation is concerned, but this amount is necessary to ensure colour stability for periods of storage up to a year. Dimensions and descriptions of the various sections of the plant are given, and photographs and a flow sheet provided. R. A. E.

685. Control of Fixed Gases in Treating Gasoline. A. C. Sturgis. *Oil & Gas J.*, 30.3.33, **31** (45), 54.—Cracked gasoline from East Texas crude is treated in a system comprising a set of baffle coils, two towers of conventional design and a 10 in. relief line, 6 ft. higher than the tower itself, braced to the side of the first tower. The relief line is equipped with an orifice plate and 2 in. valve in order to control the amount of fixed gases, which contain appreciable amounts of H_2S. It is claimed that this arrangement gives the "doctor break" in the shortest possible time and allows for changes of material or of weather conditions. Raw gasoline is pumped from the stills to the 10 in. casing, and from thence flows to the first tower into which doctor solution is pumped. A mixture of equal parts of raw and semitreated gasoline is pumped, together with doctor solution, to the contacting coils, from which

it passes back to the tower opposite to the connection on the re-circulating pump. The gasoline is then sweet, but requires settling. This is effected by allowing the treated material to flow from the top of No. 1 tower to the bottom of No. 2 tower and drawing off finished gasoline from a point near the top of No. 2 tower. Points of interest in connection with this method are: (1) Air can be admitted to the contacting coils and controlled to pass through the whole length or to be used at the point of discharge. By this means treating time can be controlled. (2) By passing a mixture of raw and semi-treated gasoline through the contacting coils, gasoline of better colour is obtained. (3) The use of the minimum amount of doctor solution necessary, and rapid treatment before the gasoline comes into contact with the atmosphere are factors leading to improved final colour. For this reason, the gasoline is passed direct from the stills to the treating plant. (4) Sulphur is not used since it adversely affects the final colour, sun test and gum content of the finished gasoline. It does give a slightly faster "doctor break," but the orifice and valve utilised in this plant achieve this object satisfactorily.

R. A. E.

686. Effect of Paraflow. H. Suida and H. Pöll. *Petr. Zeit.*, 7.6.33, **29** (23); *Motorenbetrieb*, **6** (6), 2–4.—It has been confirmed that paraflow decreases the set point, its effect varying from oil to oil. 0·2–0·3% of paraflow lowered the set point of dewaxed paraffin-base lubricating oil by 7–8° C., the same effect being observed with mixed base oils. With viscous oils of these types, no effect was observed. Asphalt base lubricating can be divided into: (*a*) those containing a small percentage of soft paraffin, and (*b*) those containing a small percentage of soft and hard paraffin and ceresin. Type (*a*) gave good results with an addition of 0·5 to 1% of paraflow, and type (*b*) gave a low set point with a similar addition, but the paraflow did not remove the turbidity experienced at room temperatures. Lubricating oils from an asphaltic base crude oil containing practically no paraffin were unaffected by paraflow. Para flow was not applicable to transformer or turbine oils since they age easily after the addition of this material. Conradson coke values are somewhat greater for oils treated with paraflow.

W. S. E. C.

687. Refining of Hydrogenated Lubricants. Y. Tanaka, R. Kobayashi and A. Misono. *J. Soc. Chem. Ind. Japan*, 1933, **36**, 227 B.—It is shown that although crude lubricating oil may be decolorised by adequate hydrogenation, the colour stability is unsatisfactory due to the ease of oxidation of the unhydrogenated colouring matter and of unstable chromogens produced by the cracking of carbonaceous materials. The colouring matter may be removed by treatment with Japanese acid clay, which has strong adsorptive powers for certain colouring matter.

W. H. T.

688. Safety Drilling as a Low Cost Insurance for Process Equipment. J. H. Hirsch. *Refiner*, 1933, **12**, 184–188.—Safety drilling consists essentially of drilling small holes in the walls of equipment, the diameter, depth, shape and spacing of such holes being fixed by specification based on experience as providing maximum protection. When the container wall has diminished in thickness to the lowest safe limit, usually one half wall thickness, leakage at the drilled points provides the necessary warning.

The holes of one-eighth to three-sixteenths inch in diameter and terminating in a cone of 90° vertex, are drilled according to a regular pattern to a depth of one half the wall thickness remaining after first subtracting an allowance for corrosion, so that the tip of the cone penetrates to the midpoint.

Examples are cited to show the efficacy of safety drilling in detecting failures not discovered by the normal safety inspection. It is emphasised

that personal injury or dangerous conditions arising from failure at the drill hole do not arise as the conical construction of the base of the drill hole permits the discharge of only a small amount of material in failure.

Safety drilling is regarded primarily as an adjunct to regular safety inspection. B. C. A.

689. Calculations for the Design of Bubble Tower Foundations. W. C. Edminster. *Nat. Petr. News*, 15.2.33, **25** (7), 35–36; 22.2.33, **25** (8), 27–30; 1.3.33, **25** (9), 35–36.—A method of design for the foundations of cylindrical towers and tanks is presented. In any tower the horizontal wind pressure tends to overturn it, while the weight of the tower, its contents and its base tend to keep it in equilibrium. Thus it is least stable when empty. In a vector diagram of forces, therefore, the resultant must in the limiting case cut the periphery of the base. For this condition we have :—

$$\frac{\left(\frac{H}{2} + \frac{P + X}{12}\right)\text{ft.}}{(W_T + W_B + W_P)\ 10^3\ \text{lbs.}} = \frac{\left(\frac{Y}{24}\right)\text{ft.}}{\left(\frac{W_L\ HD}{12}\right)}$$

Where H=height of tower in feet; P and X the thickness of pedestal and base in inches; W_T, W_B, W_P=weight of the tower, base and pedestal in 1000 lb.; Y=the diameter of the base in inches, W_L=wind load in lb. per sq. ft., and D=diameter of the tower.

W_P may be neglected as small, and substituting 133 lb. per cu. ft. for the weight of reinforced concrete, simplifying and denoting each side by F × 10^3.

$$\frac{D\ W_L}{24}\left(H^2 + \frac{P + X}{6}H\right) = F.10^3 = W_T\frac{Y}{24}\cdot 10^3 + \frac{Y^2X}{312} \quad \ldots\ldots\ldots (2)$$

A graphical diagram of this equation is given. In considering the thickness of the base and the number of reinforcing bars, the extreme case occurs with a full tower. Then if W_S=total weight in 1000 lb. on slab (including weight of slab itself) $W_S=W_T+W_L+W_P$ where W_L=weight of liquid in 1000 lb., and assumed to be water weighing 62·4 lb./cu. ft., then :

$$W_L \cdot 10^3 = \frac{62{\cdot}4\ .\ \pi\ D^2H}{4.144}\ \text{(L.L.)}$$

$$= 0{\cdot}342\ D^2H\ \text{(L.L.) lbs.}$$

$$W_B \cdot 10^3 = \frac{133}{1728}XY^2 = 0{\cdot}077\ XY^2\ \text{lbs.}$$

If the pedestal is octagonal :

$$W_P \cdot 10^3 = \frac{133\ .\ 0{\cdot}8284pq^2}{1728} = 0{\cdot}0638pq^2\ \text{lbs.}$$

when X=thickness of the base, and q=the smaller width of the pedestal. A second graph gives values of W_P, W_B and W_L for various liquid levels in the tower.

Assume the base to be a simple beam supported at its ends and bearing a uniformly distributed load W_S. The maximum moment will be at L inches from the end or under the edge of the pedestal. The moment at this point is :

$$M = \frac{W\ Y\ L}{2} - \frac{W\ L^2}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where W = the unit load = $\frac{W_S}{Y}$, and L = distance in inches from the edge of the pedestal to the edge of the base.

Let $r_D = \frac{Y}{q}$.

Knowing Y and q determines L and r_D which are related. Equation (3) then becomes $M = \frac{W_S Y^2}{C_m q}$ ..... (4)

where $C_m = 20$ = a constant.

Then data from reference tables of strengths of materials, etc., and further simple substitution, leads to

$$Z = r_D \sqrt{\frac{W_S}{20K}} \quad \ldots\ldots (5)$$

where Z is the thickness of the base above the reinforcing bars, and K is a constant = $\frac{M}{qZ^3}$.

$$\text{Now } r_R = \frac{\text{area in sq. in. of reinforcing bars}}{\text{area in sq. in. of concrete above bars,}}$$

and R = total area of steel in sq. in. in one of the four planes around the pedestal. Then:

$$R = \frac{3{\cdot}31\, q\, Z r_R}{4} \quad \ldots\ldots (6)$$

where 3·31q = perimeter of the pedestal, from which the number of bars can be calculated by dividing by the cross sectional area of the bar. Further graphs facilitate calculation from these equations.

Now for the design of anchor bolt settings, the resisting moment M_R of the anchor bolt must equal or be greater than the wind moment M_W.

Therefore:

$$M_W = \frac{W_L}{24} DH^2 = CDH^2 \quad \ldots\ldots (8)$$

M_R varies as the diameter of the bolt circle, the size of the bolts and the allowable unit stress in the bolts. A diagram discusses the conditions arising with 4, 6, 8 and 12 bolts. If the bolt circle diameter = b and the width of the flange beyond the bolts = a, the lever arm =

$$\frac{b}{2} + \frac{2}{3}\left(\frac{b}{2} + a\right) = \frac{5}{6}b + \frac{2}{3}a$$

and the following expression is derived:

$$M_R = Bbd^2 S_S \quad \ldots\ldots (9)$$

where d = diameter in inches of the anchor bolts, S_S = unit stress in lb./sq. in. in the steel, B = a constant of magnitude depending on the number of bolts. The following values are given for B: 4 bolts 0·0545, 6 bolts 0·1007, 8 bolts 0·1285, 12 bolts 0·212.

Therefore in the limiting case $M_R = M_W$:

$$Bbd^2 S_S = CDH^2 \quad \ldots\ldots (10)$$

A final chart gives the data to be deduced from this equation. H. G.

690. Nickel and Nickel Alloys for Oil Refinery Equipment. O. B. J. Fraser. *Refiner*, 1933, **12**, 162–173.—Nickel alloys have been used in refinery construction since 1910, when 50,000 Monel metal bolts were used for the jointing of cast iron condensers cooled with seawater. After 21 years' use, the bolts examined showed practically no alteration from the original condition. Monel metal rods are used in pumps handling light oils and distillates at moderate temperature, for water pumps, and for pumps handling hot acid sludge. Monel metal trimmed valves serve for high pressure steam and for caustic solutions, hot salt water and dilute acids. In hot oil lines, especially where the oil is high in sulphur, better results are obtained with stainless steel. Monel metal is used for oil burner tips and modifications are available which can be hardened to 350 Brinell. In the sheet form Monel metal is utilised for resistance to corrosion of the types previously mentioned.

Copper-nickel alloys containing less than 50% of nickel constitute relatively low cost materials of excellent mechanical properties and corrosion resistance. Refinery tests have shown for tubes of 20% nickel content, five times the life of Admiralty metal tubes. Other alloys of merit are a copper nickel alloy and a copper-aluminium-nickel alloy, each containing 4% of nickel.

Inconel, a chromium-nickel alloy, containing about 14% of chromium and produced in the same mill form and finishes as nickel and Monel metal is more resistant to sulphurisation and to many aqueous corrosives than either. It has the same thermal expansion as steel, is slightly more rigid and has a greater toughness than steel and other non-ferrous alloys. It welds readily the welds being sound, strong and ductile.

Nickel clad steel plate is produced by a hot rolling process, the nickel layer constituting 10–20% of the total plate thickness, being bound at the interface by a solid solution alloy. The material can be fabricated like steel, and the cost approximates closer to steel than to nickel. In fabricated equipment the continuity of the nickel surface is effected by the riveting of lap joints with pure nickel rivets plus caulk welding of the open seam with pure nickel welding wire. The nickel surface affords the protection associated with this metal, and the material is suitable for a variety of uses in the face of corrosive conditions.

Steels are alloyed with other elements to obtain special mechanical properties or to improve corrosion resistance, and for the former the additions are not usually more than 5% of any one element. Relatively little use is made of simple nickel steels in refinery construction, but the toughness and ageing resistance of steels containing 0·15–0·20% carbon and 2·00–2·25% nickel coupled with a retention of impact strength at low temperatures suggests that for special applications they should prove valuable. Examples are given of steels of low nickel-chromium content for use under high temperature and pressure conditions. Cast nickel-chromium-molybdenum steels, containing about 1·75% nickel, 0·70% chromium, 0·20% of molybdenum are widely used for high temperature service and have a superior creep resistance to the straight nickel-chromium type.

High nickel-chromium alloy steels are used by reason of their corrosion resistance, but principally on account of load carrying ability and resistance to sulphurisation and oxidation at high temperatures. These steels frequently contain tungsten and/or molybdenum, etc., and some contain aluminium. The austenitic 18–8 chromium nickel alloy is mostly used, particularly for radiant section tubes and transfer lines. Providing tube wall temperatures are not allowed to rise above 1250° F. tube failure is avoided. Variants in this composition together with their uses are described.

Alloy cast irons have come into general industrial application within the past ten years. As with the steels, they may be divided into two groups,

the dividing line being an arbitrary one of 5% total alloy addition. Below 5% alloying improves the physical properties to the greater degree, and above 5% the corrosion resistance and structural stability. Low alloy irons are used in quantity for bubble caps and trays; also for lower still tube supports, giving more than three times the service of cast iron. Although used at temperatures up to, say, 1000° F. metal temperature, they are not specifically heat resisting alloys, but compared with cast iron are stronger at all temperatures within the utility limit, possess an enhanced resistance to scaling and have a greater structural stability.

High alloy cast irons are illustrated by an example containing 3·0–6·0% nickel 0·5–2·50% chromium, which is used more by reason of its strength, hardness and wear resistance rather than for a superior corrosion resistance to cast iron. This type attains a Brinell hardness on the chilled face of from 500 to 750 as against 380–530 for corresponding grades of grey iron. An alloy containing 14% nickel, 6% copper and 1·5% or more of chromium has been found widely applicable to the refining industry. Its castings are tough, dense, pressure tight and resistant to wear and many corrosive conditions. The alloy is also highly resistant to scaling, warping and growth at temperatures up to 1500° F. Instances of its use under corrosive conditions, including the handling of acid, acid sludge, oil and caustic are quoted.

A bibliography of nine references is appended. B. C. A.

691. Welding Corrosion-Resistant Irons and Steels. J. C. Hodge. *Refiner*, 1933, **12**, 189–197.—In the process of welding plain carbon steels, the molten metal readily combines with atmospheric oxygen and nitrogen, resulting in elimination of carbon, manganese and silicon, and in the absorption of nitrogen. These changes may be greatly reduced by the use of covered electrodes, and the resulting weld is at least as corrosion resistant as the parent low carbon steel.

The above changes are accentuated in the case of the corrosion resistant alloys, chromium being readily oxidisable and having a marked affinity for nitrogen. The effects are reduced by the use of coated electrodes, the coating usually containing an element such as ferro-manganese, ferro-titanium or aluminium possessing a preferential affinity for oxygen and nitrogen.

The 4–6% chromium irons owing to air hardening tendencies are of limited weldability, although sections of moderate size may be welded without danger of cracking. The finished welds require annealing to produce maximum ductility and softness. An 18–8 electrode may be substituted to eliminate the danger of cracking, provided that the welded part is not required to be annealed and that service conditions will not cause failure by reason of the different coefficients of expansion.

The minimum chromium content to secure a steel stainless to oxidising influences is approximately 12%. Such alloys are, however, air hardening and welded, and adjacent areas are hard, brittle and liable to cracking.

By increasing the chromium content to 16–18%, corrosion resistance is greatly enhanced and such alloys weld readily, producing a weld which, although brittle as welded, when annealed at 1500° F. acquires ductility and impact resistance.

The chrome-nickel steels containing a minimum of 18% chromium and 8% nickel possess to an enhanced degree the stainlessness of straight chromium-steels under oxidising conditions as well as resistance to mineral corrosive attack, which the latter lack. These alloys weld readily, producing a strong and ductile weld. To retard the precipitation of carbide during welding, the addition of titanium in about six times the carbon content is effective.

Higher chrome-nickel steels, with or without added molybdenum, also weld readily, in a manner similar to 18–8. Composite plates of low carbon

steel plate clad with 18–8 may be welded, employing low carbon steel electrodes for the steel side and 18–8 electrodes for the alloy steel side. Such a weld cannot be heat treated, as the correct heat treatment for either would impair the properties of the other. B. C. A.

692. Tube Wall Telescope for Examination of the Interior of Tubes and Piping. Anon. *Refiner*, 1933, **12**, 198–199.—Visual observation of the interior walls of tubes may be accomplished by the use of a tube wall telescope, which can be obtained to observe tubes up to 40 ft. in length by insertion of the telescope at each end. Illumination is by small electric tubular lamp. Auxiliary photographic equipment is available. B. C. A.

693. Use of Instruments in Refining. V. R. Chadbourne. *Refiner*, 1933, **12**, 200–202.—The growth in complexity and size of refinery units has been accompanied by the installation of measurement and control devices. The efficient use of such devices is dependent upon a number of factors, of which the most important are: (1) selection of the proper instruments for the jobs; (2) correct installation; (3) proper maintenance; and (4) intelligent interpretation of the records. B. C. A.

694. Problems of the Pressure Vessel User. II. T. McL. Jasper, O. E. Andrus and L. J. Larson. *Refiner*, 1933, **12**, 174–179.—Cylindrical vessels dominate the field of pressure vessel service, due to convenience in use and fabrication. It is essential to use heads of proper shape and adequate reinforcement of openings if the greatest strength for a given weight is to be obtained. The application of welding to correct design features has markedly affected the safety of vessel operation. Curves are given showing the deformation in strain gauge units against pressure in lb./sq. in. for cylinder wall, unreinforced and reinforced manway openings and dished and elliptical heads, obtained with a 6 ft. diameter steel vessel, length 40–50 ft. and 2 in. wall thickness. The vessel was successively tested to failure at the unreinforced manway opening and the dished head. By reinforcing the manway and the substitution of an elliptical head the yield point of the parts enumerated was practically uniform, demonstrating the possibility of obtaining, through the use of welding and correct design, the full strength of the materials used.

The use of high pressure demands thick wall vessels. When fabricated in thick plates, a stiff structure results which bursts with a shattering effect when tested to destruction. The use of a number of thin plates superimposed has overcome this difficulty and is productive of improved strength. This mode of construction also permits of the incorporation of corrosion-resistant liners, which are spot-welded at frequent intervals to the carbon steel vessel, and which afford many years protection under severe conditions.

The corrosion of non-lined vessels may be followed by means of non-corrosive alloy buttons fastened to the inner surface, which stand out as corrosion progresses. B. C. A.

695. Characteristics of Steel at Elevated Temperatures. F. B. Foley. *Refiner*, 1933, **12**, 180–183.—The use of carbon steel is limited to low temperatures up to 850° F. because of its low physical strength when heated and low oxidation resistance. Low alloy pearlitic steels are used up to 1100° F. and possess increased strength and scaling resistance. For forecasting the behaviour of steels short-time tensile test results at varying temperatures are of limited utility and creep testing under accurately controlled testing conditions are necessary for dependable values.

For higher temperature service, a range of steels of increasing chromium content up to above 30% chromium are available, but are characterised by

rapid grain growth at high temperature, a tendency which is reduced by the addition of nickel. At high temperatures of above 1600° F. creep testing is at present impractical and reliance has to be placed on results from short-time tensile tests, coupled with service experience.

The effect of temperature on chemical and physical stability is shown in three ways: (1) reduction in corrosion resistance at atmospheric temperatures after exposure to temperatures of 1100–1600° F.; (2) reduced ductility at room temperature after similar exposure, which may not, however, be of significance if the metal is to be used at elevated temperatures; and (3) a reduced ductility manifested within a certain temperature range, depending upon the composition and the metallographical condition. Data are given to illustrate the effects. B. C. A.

696. Fusion Welding of Pressure Vessels. J. K. Veeder. *Petr. World* (*L. A.*), 1933, **30** (4), 41–44.—The demand during recent years for increased size of pressure vessels that will withstand much higher pressures and temperatures has drawn attention to the possibilities of using welded construction instead of the more expensive forging and rolling methods. Electric fusion welding has been developed and by using an electrode with a special coating successful results were obtained in manufacturing drums for high-pressure boilers and other equipment. The methods of testing the soundness of the weld were briefly as follows: The fusion welded test shells were strain-annealed at 1200° F. before test. The test pressures were alternated from zero to that which produced a stress of 16,500 lb./sq. in. in the plate and across the weld. This corresponds to basing the working pressure for a safety factor of 5 on a stress of 11,000 lb./sq. in., which involves the use of a welded joint as strong as the plate. The shell withstood 1,993,450 cycles of stress without failure. The second test method utilised X-rays; the equipment consisted of a Wappler double-disc, high-potential power plant, capable of delivering 10 milliamps. at 300,000 volts. X-ray examination of sections of longitudinal and circumferential welds up to 3–4 in. thick were possible. The satisfactory data obtained in these tests resulted in the acceptance of fusion-welded drums by the U.S. Navy and the National Board of Underwriters.

G. R. N.

697. Mean Temperature Differences in Multipass Heat Exchangers. W. M. Nagle. *Ind. Eng. Chem.*, 1933, **25**, 604.—Charts are developed whereby the mean temperature difference in multipass heat exchangers may be calculated. The charts give correction factors by which the logarithmic mean temperature difference for counterflow may be multiplied to give the mean temperature difference for multipass exchangers. These correction factors depend only on the number of passes in the exchanger and on certain dimensionless ratios involving the inlet and outlet temperatures of the two fluids. The deviation of equations for mean temperature difference are given in detail for the exchanger having one pass shell-side and two passes tube-side and for the exchanger having two passes shell-side and four passes tube-side. The assumptions involved are those made in the deviation of the logarithmic mean temperature difference plus the additional assumption of good mixing of the shell-side fluid. W. H. T.

698. Corrosion Fundamentals. C. E. Beynon. *J.S.C.I.*, 1933, **52**, 359–363.—This paper is an interesting theoretical survey of the fundamentals of corrosion. The isolation of protective films responsible for the passivity of treated metal surfaces is discussed. Corrosion of metals in direct contact is dealt with and the dangerous effect of this type of corrosion on yacht construction is quoted. The differential aeration theory is studied at length,

and the work of Tammann and his co-workers, who forced dye solutions under high pressure into the interior of metallic specimens to show presence of channels of capillary size, is considered. The study of the corrosive effect of sand, seaweed, etc., on marine condenser tubes is mentioned. W. A. W.

699. Development and Trend in Ferrous Alloys Used with High Temperatures. F. N. Speller. *Oil & Gas J.*, 16.2.33, **31** (39), 74.—The principles underlying the development of alloys resistant to high temperature and corrosion are discussed and the views of several investigators on the effect of high temperatures on the structure and properties of ferrous metals quoted. A consideration of the protective films given by anti-corrosive alloys in various media leads to the conclusion that no one metal can be economically used to resist all types of corrosion at high temperatures. Graphs are given showing the degree of corrosion of steels of increasing chromium content in various environments, as well as the corrosion resistance of chromium alloy steels compared with regular carbon steel. The criteria of efficient surface film protection are given, and it is stated that so far no metal of reasonable price has been found which will resist concentrated chlorides at high temperature. More progress has been made in the study of resistance of metals to corrosion than to elevated temperatures.

E. C. Wright (see also *Oil & Gas J.*, 6.10.32, p, 57) discusses the influence of temperature on the physical properties of various steels. Carbon steel which has been normalised by annealing at temperatures above 1650° F. is affected by subsequent heating at temperatures of 1300° F., the carbide particles becoming spheroidised with consequent loss of strength. This spheroidisation has been shown to occur in actual practice in boilers and cracking stills, the effect being proportional to the time of exposure, temperature of heating, and carbon content of the steel, particularly in the presence of mechanical stresses. Ordinary steels, heat-treated steels, and, in particular, Austenitic type alloys are subject to this deterioration in strength. It is emphasised that to avoid such changes, either metals must be selected which will not undergo this change or the metal must be so treated that it will be stable under operating conditions. Tests such as creep tests must be carried out on the metal in the actual physical state (*i.e.*, the spheroidised state) in which they will be after a period of service. Plain chromium alloys used at high temperatures should not be allowed to cool through the embrittling range, while austenitic steels should be processed so as to prevent injurious grain boundary defects. The creep test should be carried out under very carefully-regulated conditions, particular attention being paid to (1) uniformity of sample in structural stability throughout test; (2) loading with stresses corresponding to practical conditions; (3) close control of temperature; (4) precise measurement of temperature and strain; (5) length of tests should approximate to expected life of material, at least one or two years being essential.

H. J. French describes the work of the Joint Research Committee of the A.S.M.E. and the A.S.T.M. on the Effect of Temperature upon the Properties of Metal, and points out that at ordinary temperatures the limiting stresses for design purposes are the repeatedly applied stresses (resistance to fatigue), whereas there is evidence to show that the limiting stresses for ordinary carbon steels at 1000° F. are not the repeatedly applied stresses, but the ability of the metal to sustain fixed loads (resistance to creep). Work on this question is in hand, as well as on the definition of the temperature ranges within which the repeatedly applied stresses and the ability to sustain fixed loads become the limiting stresses for design purposes of austenitic chromium steels.

It is suggested that the refinery division of the A.P.I. should co-operate with manufacturers and with the above committees to draw up standard methods for the preparation of samples and for creep testing.

R. H. Aborn describes the changes occurring in 18·8 steel between 900° F. and 1400° F. and indicates two promising methods of combating strength reduction on heating. With austenitic chromium steels, chromium carbide, or a chromium-rich carbide, precipitates at the grain boundaries of the metal, the adjacent metal being thereby weakened in chromium and subject to corrosion attacks, particularly in the case of high carbon steels.

Reduction of the carbon content is impracticable, but the addition of elements which form extremely stable carbides, *e.g.*, titanium, is successful in leaving the chromium distribution impaired on heating. Practical experience of alloys containing titanium to the extent of 5–6 times the carbon content has demonstrated their serviceability. A second method consists of a combination of mechanical and thermal treatment, which induces the carbide to precipitate through the grains as well as (or perhaps instead of) along the boundaries. Photomicrographs indicate the improved structure, while it is stated that the treatment may reduce the ductility slightly but increases the strength. The relative susceptibility to intergranular attack of 18/8 alloy (*a*) ordinary, (*b*) after cold and heat treatment and (*c*) containing titanium after 1000 hours' exposure to acid at various temperatures is graphically illustrated.

In place of using alloy steels, various protective measures for equipment have been used, *e.g.*, more complete separation of salt water and use of neutralisers, use of cement mixture liners and alloy linings. The trend in the use of heat-resisting alloys is discussed and it is emphasised that it is the experience of consumers which determines this development, so that an expression of their views would be very helpful to manufacturers.

C. L. G.

700. Patents on Cracking.—M. Schuster. E.P. 391,238, 27.4.33. The stock is heated in a pipe-still at a relatively low pressure and the vapours passed to a dephlegmator where partial condensation takes place. The heavier fraction thus obtained forms the charging stock for a similar pipe-still operating at a higher pressure. In both cases means are provided for recycling residue. S. B.

P. Guichard. E.P. 392,358, 18.5.33. A cracking plant with a plurality of reaction vessels each provided with internal cleaning means, and any one of which may be put out of operation during the working of the plant. The reactions are fitted with pyrometers for giving warning of blockage of the vessel.

C. Andrews. U.S.P. 1,907,029, 2.5.33. A plant for coking heavy residues and cracking the resultant vapours at atmospheric pressure by direct contact with hot non-oxidising (flue) gas.

H. Snow. U.S.P. 1,908,001, 9.5.33. Means are described for spraying a cooling liquid on to the outlet conduit of a reaction chamber, whereby coke deposition is retarded.

J. C. Black. U.S.P. 1,908,106, 9.5.33. A liquid phase process employing a double pipe heater in conjunction with heat exchangers, evaporator, etc.

V. Browne. U.S.P. 1,908,889, 16.5.33. A martensitic alloy steel tube for cracking plants is described. It is claimed to be of relatively great strength and to resist corrosion, oxidation and embrittlement. The composition is 0·12% carbon, 12–14% chromium and 2–4% tungsten, the balance being iron.

J. Kuhl. U.S.P. 1,909,587, 16.5.33. Treatment of residual bodies resulting from the reaction of petroleum oils with metallic halides. The atomised tar is passed counter-current to heated gases in a retort in the bottom of which carbonised material is collected.

S. Yeaton. U.S.P. 1,909,600, 16.5.33. Unvaporised carbon-containing hydrocarbons are removed from the cracking system intermittently, the flow of recycle reflux condensate being diverted during each removal.

H. Pelzer. U.S.P. 1,910,048, 23.5.33. A liquid-phase process in which provision is made for uniform heat distribution on the oil-heating surfaces. A large bulk of oil is circulated at high velocity and under severe cracking conditions.

M. Chittick. U.S.P. 1,910,242, 23.5.33. A tubular converter in which the tubes are fitted with cores consisting of helical metallic strips. This arrangement gives a turbulent flow of oil or vapour, a more uniform heating being obtained thereby.

A. Pew. U.S.P. 1,910,812, 23.5.33. Oil is vaporised under pressure and then dried by suddenly reducing the pressure. The oil vapours are then cracked under the reduced pressure, cooled and fractionated.

H. Snow. U.S.P. 1,911,476, 30.5.33. An inlet nozzle for introducing heated oil vapours into a converter. W. H. T.

701. Patents on Hydrogenation.—Chemical Reactions, Ltd. E.P. 389,560, 23.3.33. Owing to the exothermic character of the reaction, local overheating and consequent deterioration of the catalyst in the reaction vessels employed in the hydrogenation of carbonaceous material is prevented by the injection of cold oil, preferably a fraction of the hydrogenated product, into zones determined by pyrometric control. In this way a more uniform reaction etmperature is maintained in the interior of the reaction vessel.

Chemical Reactions, Ltd. E.P. 389,937, 30.3.33. This describes an arrangement of heat exchangers, separators and a rectifying column in connection with any cracking or hydrogenation process for heavy oils involving high working pressures. The greater part of the product condenses, and the gases and vapours separated from the condensed liquid are cooled under the working pressure to normal temperature, the constituents of the product thus condensed having their pressure released and being led together with the hot liquid product into the rectifying column. The heat taken up in the heat exchangers is transferred to the evaporating chamber or to the stripping sections of the column. S. B.

I. G. Farbenind A.-G. E.P. 391,283, 27.4.33. Colour stability of hydrogenated products is claimed to be obtained by washing with a 5% alkali solution under reaction pressure after the hydrogen has been removed but before contact with air or oxygen has taken place. The alkali wash is followed by a reduction of the pressure to 20 atm. press. and a water wash. S. B.

R. A. Taylor. E.P. 391,988, 11.5.33. A catalyst for hydrogenation of organic material. An inorganic gel is caused to adsorb a compound of a metal (molybdenum) in the vapour or liquid phase or from a solution or dispersion of the compound in a non-aqueous and non-hygroscopic medium.

E. Dorrer. U.S.P. 1,908,286, 9.5.33. A hydrogenation process using a catalyst consisting of a metal from the 4th to 6th group of the periodic system with a metalloid from the 6th group. The time of reaction is sufficient for the conversion of sulphur, oxygen, nitrogen and halogen compounds into hydrides of these elements but insufficient to effect any appreciable splitting up of initial hydrocarbons. The hydrides are separated and hydrogenation continued in order to effect saturation of olefines, etc.

M. Pier. U.S.P. 1,910,050, 23.5.33. Production of non-knocking motor fuel by the destructive hydrogenation of an oil deficient in hydrogen (*e.g.*, SO_2 extract).

M. Pier. U.S.P. 1,910,051, 23.5.33. Production of non-knocking motor fuel by the destructive hydrogenation of an aromatic middle oil.

J. Maruhn. U.S.P. 1,911,909, 30.5.33. Hydrogenation apparatus consisting of a piston adapted to work in a compression chamber in which the reaction takes place.

W. Tate (I.C.I.). U.S.P. 1,911,933, 30.5.33. Hydrogenation apparatus which includes peripheral heating of the reaction space by hot gas and peripheral cooling of the external pressure resisting wall by coal gas. Both gases participate in the reaction.

R. Haslam. U.S.P. 1,912,136, 30.5.33. Recovery of unused free hydrogen from hydrogenated vapours. The latter are first contacted under the reaction pressure with a high boiling hydrocarbon and then with a lower boiling material, whereby all normally liquid hydrocarbons are condensed. The remaining uncondensed gas consists largely of free hydrogen. W. H. T.

702. Patents on Motor Fuel. M. Taylor. U.S.P. 1,908,273, 9.5.33. Sweetening by means of an acid aqueous solution of a chlorite of an alkali metal.

T. Gray. U.S.P. 1,908,599, 9.5.33. Vapour-phase refining of cracked distillates by passage through a series of beds of solid adsorbent. The vapours and polymers issuing from any one bed are separated and only the vapours passed to the next bed.

E. Herthel. U.S.P. 1,908,606, 9.5.33. A combined vapour-phase cracking and refining process in which a partial condensate is produced from the fractionated vapours before contacting with the adsorptive. The condensate is brought into contact with the vapours in the fractionator, the amount being varied in order to control the operation of the fractionator.

J. Hirt. U.S.P. 1,910,288, 23.5.33. Desulphurisation by treatment with the dry hydrous reaction product of a caustic soda solution, litharge and caustic lime at a temperature below that at which dehydration will occur.

M. Yonker. U.S.P. 1,910,734, 23.5.33. Removal of gum-forming and sulphur compounds by treatment in the vapour-phase with oxygen at 300°–350° F.

J. Morrell. U.S.P. 1,911,640, 30.5.33. Sweetening by treatment with a solid reagent, comprising a copper salt, a hydroxide of an alkali metal, an oxide of an alkaline earth metal and a solid adsorbent material. W. H. T.

703. Patents on Lubricating Oil. H. Atwell. E.P. 390,222, 6.4.33. Dewaxing of oil, liquefied petroleum gases being used as diluent, controlled evaporation of the diluent affording the necessary refrigeration. The wax separates in an easily removable form. Mixing takes place in a closed system, the oil being agitated with twice its volume of liquefied propane, butane, etc. Evaporation is from a distilling chamber, control being effected by means of a pump. S. B.

W. Baylis. U.S.P. 1,906,356, 2.5.33. Removal of colour and colloidal impurities from oil by filtration through filter paper containing an activated clay.

F. Ebaugh. U.S.P. 1,906,951, 2.5.33. A method for intimately mixing two or more liquids or for the dispersion of a finely divided solid (clay) in a liquid (oil). The apparatus comprises a nozzle which injects into a series of short cylindrical chambers joined together at right angles.

J. Anderson. U.S.P. 1,907,703, 9.5.33. Precipitation of wax from an oil-wax mixture by means of a cold diluent (–10° F.) comprising an acetone-benzole mixture. The proportions of the latter are varied according to the type of oil being treated.

L. Henderson. U.S.P. 1,908,018, 9.5.33. Separation of oil into paraffin and naphthene components by fractional extraction with ethylene glycol ethers and their acyl derivatives.

E. Petty. U.S.P. 1,908,616, 9.5.33. Tar is removed from acid treated oil by centrifuging, the oil then being contacted with clay. The spent acid is used for pretreating the oil prior to contacting with fresh acid.

I. Rosenberg. U.S.P. 1,908,646, 9.5.33. SO_2 treatment of a total distillate (I.B.P. 100° C., F.B.P. 400° C.) from crude oil. The mixture is separated into a raffinate and an extract portion and SO_2 removed from both.

J. Schaeffer. U.S.P. 1,908,923 and 4, 16.5.33. Apparatus for atomising oil with acid, agitating the mixture, coalescing the reacting materials and finally continuously separating the products of the reaction.

E. Birkhimer. U.S.P. 1,910,422, 23.5.33. Fractional extraction of heavy oils with an aliphatic aldehyde mixture to give paraffinic and naphthenic fractions.

A. Higgins. U S.P. 1,910,920, 23.5.33. Sweating paraffin wax by conveying the material upwardly through a zone of controlled temperature in a bucket conveyor. Each bucket has a reticulated bottom whereby melted material falls into the bucket beneath, the desired crystalline material being withdrawn from the top of the zone.

G. Coubrough. U.S.P. 1,911,992, 30.5.33. Vaporisation of wax-bearing-oils with steam. The vapour mixture is passed counter-current to a liquid non-emulsifiable oil which will substitute the wax bearing oil, the mixture of steam and non-emulsifiable oil being subsequently condensed.

M. Tuttle. U.S.P. 1,912,348, 30.5.33. Fractional extraction of heavy oils with a wood tar acid, to give paraffinic and naphthenic fractions. U.S.P. 1,912,349 specifies the use of cresylic acid. W. H. T.

704. Patents on Asphalts and Fluxes. Colas Products, Ltd. E.P. 389,810, 20.3.33. Production of bituminous emulsions of high viscosity by the use of a dispersion medium consisting of a mixture of a water soluble salt and a carbohydrate (gelatine) The mixture absorbs water from the continuous phase, thereby increasing the concentration of the disperse phase with consequent increase in viscosity

W. Paynter. E.P. 389,906, 30.3.33. Improvements in heaters for melting bituminous materials. Primary and secondary tanks for holding the molten and fresh material respectively are provided. They are both heated by a single furnace which also contains means for heating compressed air. The latter is used in connection with the actual application of the bitumen. S. B.

P. Lechler. E.P. 392,365, 18.5.33. Manufacture of bituminous emulsions by treatment of the molten asphaltic-bitumen with one or more hydrates or carbonates of the alkali metals (5% of NaOH or KOH) at 120° C. Emulsification is then effected in any suitable manner using soap or clay as emulsifying agent.

W. Paynter. E.P. 392,577, 17 5.33. Coating aggregate with asphaltic bitumen using a cascading chamber through which hot dry air is circulated. Hot air under pressure is employed to spray hot atomised bitumen into the chamber so that the matrix is maintained at its correct temperature.

R. Edgeworth-Johnstone. E.P. 392,620, 25.5.33. Production of mixtures of bitumen and rock aggregate. Steam and bitumen are introduced simultaneously into a receptacle containing the aggregate.

P. Alexandroff E.P. 392,645, 25.5.33. A road-making mixture consisting of 6 parts of a 34% (by wt.) residue from standard (B S I.) creosote, with 94 parts (by wt.) of asphaltic bitumen of 45 penetration. The mixture which has a penetration of 106 at 25° C. is cut back with a petroleum distillate to a viscosity (Red. II.) at 100° F. of 1740 secs.

E. Gard. U.S.P. 1,911,114, 23.5.33. Production of blown asphalt by treatment of oil with air at elevated temperatures. Vapours are separated from the oil and a portion of the condensate is returned to the oil undergoing oxidation. W. H. T.

705. Patents on Gas. Bat. Petr. Mij. E.P. 391,532, 4.5.33. Thermal decomposition of methane or natural gas with injection of untreated gas into the stream of cracked material as it leaves the converter. This procedure is claimed to reduce waste of heat.

Stand. Oil Devel. Co. E.P. 391,660, 4.5.33. Desulphurising of gaseous petroleum products by passage at 700–900° F. over a catalyst comprising ferrous sulphate with or without a promoter. The latter is selected from a group comprising the oxides and sulphides of metals of the third and sixth groups of the periodic table. Organic sulphur compounds are thus converted into hydrogen sulphide which is removed by passage of the treated gas over a metallic or oxide mass capable of absorbing hydrogen sulphide.

Ruhrchemie A.-G. E.P. 391,206, 18.4.33. Conversion of methane or natural gas at high temperature under a partial vacuum (1/10th atm.) in conversion chambers containing a catalyst. The chambers are heated by burning gases in adjacent chambers in which a partial vacuum of approximately the same degree is maintained.

W. C. Holmes. E.P. 392,553, 17.5.33. Preparation of combustible gas from carbonaceous materials by contact of the latter with water vapour at an elevated temperature. The water vapour is obtained by the evaporation of ammoniacal liquor with indirect heating.

Bat. Petr. Mij. E.P. 392,643 and 5, 25.5.33. Thermal decomposition of hydrocarbons in a chamber containing heated refractory material through which the gases are passed upwardly.

E. Reid. U.S.P. 1,912,009, 30.5.33. Conversion of hydrocarbon gases into motor fuels, gas oils and lubricating oils. The gases are converted by heating into unsaturated compounds, the major quantity of free hydrogen is removed and the olefines polymerised to form higher boiling hydrocarbons. W. H. T.

706. Patents on Special Products. Deutsche Gold-u. Selber Scheideanstalt. E.P. 391,213, 24.4.33. Dehydration of ethyl alcohol. Provision is made for the continuous regeneration of the fusible dehydrating agent (potas. acetate) by its removal from the dehydrating column to a heating pan where dehydration and fusion is effected. The molten mass is mixed with some of the condensed anhydrous alcohol and passed to the column where countercurrent washing of the aqueous alcohol vapour is carried out. S. B.

Distillers Co. E.P. 392,685, 25.5.33. Production of ethyl alcohol by direct combination of ethylene with water vapour. The combination is effected at elevated temperature (100–300° C.) and at atmospheric or super-atmospheric pressure (100 atm.) in the presence of a catalyst. The latter is compounded from phosphoric acid, and either or both copper and manganese or their oxides or compounds easily decomposed with phosphoric acid. The amount of the latter is in excess of that required to form the ortho phosphate but not in excess of 95%.

S. Campbell. U.S.P. 1,907,318, 2.5.33. Recovery of acidic and basic impurities from spent acid and alkali used in the treatment of petroleum distillates. The mixtures are applied to the treatment of ores as frothing agents in the flotation process.

A. Osterberg. U.S.P. 1,908,176, 9.5.33. An ointment for the treatment of eczema consisting of ether-soluble coal tar distillate, pulverised zinc oxide, starch and yellow petrolatum. W. H. T.

707. Patents on Refinery Plant. Edeleanu Ges. E.P. 391,308, 27.4.33. Removal of water which may collect in the system. It has been found that the main quantity of water entering the installation evaporates in the condenser pressure stage of the extract side. According to the invention, the water is removed from the circulating SO_2 by passing vapours liberated in the condenser pressure evaporator through a drying device such as drying towers sprayed with sulphuric acid or a rectification column. S. B.

A. MacCubbin. U.S.P. 1,907,328, 2.5.33. Pipe still distillation supplemented by vacuum distillation, thereby saving heat, increasing the yield of uncracked distillate, and lowering the temperature of the residual oil.

C. R. Faben. U.S.P. 1,907,767, 9.5.33. Distillation, using direct contact of hot flue gases as heating medium. The furnace is operated under forced draught, a partial vacuum is applied to the condenser, and the oxygen content of the flue gases is kept at a minimum.

C. Lucke. U.S.P. 1,908,374, 9.5.33. A pipe heater in which the tubes are shielded from radiant heat by means of tubes with refractory jackets. In U.S.P. 1,908,375, the shielding is effected by means of water tubes

O. C. Brewster. U.S.P. 1,909,335, 16.5.33. A combined pipe still distillation and oxidising unit for the production of distillate and asphalt.

O. Behimer. U.S.P. 1,910,587, 23.5.33. A fractionating column in which reflux liquid is taken to the top from some point in the system at which the pressure is substantially the same as that maintained on the tower itself.

W. Bahlke. U.S.P. 1,910,667, 23.5.33. A pipe still distillation unit for the separation of several finished products Partial condensation and steam stripping is used.

N. Loomis. U.S.P. 1,911,836, 30.5.33. Production of distillate and oil-free coke by heating, reducing pressure and atomising the stock. Oxidising gas is injected into the flow of atomised material, thereby causing partial combustion and volatilisation of all volatile products.

G. Coubrough. U.S.P. 1,911,993, 30.5.33. Distillation of heavy oil with minimum decomposition for the production of uncracked distillate and asphalt. A body of asphalt having a high heat storage capacity is circulated through a vaporising zone in admixture with the charge of asphaltic residue. Oil is vaporised from the mixture by counter-current contact with steam. W. H. T.

Class 700. Utilisation.

708. Relation of Lubricant and Fuel to Carbon Formation. P. W. Stroud. *Oil & Gas J.*, 6.4.33, **31** (46), 12.—The basic cause of deposits of gummy or carbonaceous material in an internal combustion engine is incomplete combustion, whether of fuel or of lubricant. Since partial combustion of the lubricant is inevitable, whereas motor fuel is introduced under conditions that favour complete burning, it is only natural that in looking for the cause of carbon formation attention is mainly focussed on the properties of the lubricant.

The influence of the motor fuel is often overlooked, but its importance is illustrated by the extensive damage caused to eight engines within a few days by the use of a gasoline containing 580 mgms. of gum per 100 ml. by the air jet method.

Assuming that oil of the correct viscosity is supplied to the engine, properties of the lubricant affecting carbon formation are (1) thermal stability, or resistance to changes due to high temperatures; (2) chemical stability, or ability to resist changes due to partial oxidation in an engine. As regards thermal stability it is found that (1) oils of high viscosity are more subject to change than those of low viscosity; (2) blends of viscous and non-viscous oils are less stable than straight-cut oils of the same viscosity range; (3) blends containing residual stock are less stable than (2). The test usually applied to indicate thermal stability is the Conradson carbon residue test, and an outline is given of its value in predicting engine performance of a lubricant. Chemical stability is of importance because oxidation leads to the formation of unstable acidic reaction products, which polymerise to resinic and finally to asphaltic materials, and adversely affect the value of the lubricant. Present day tests for the chemical stability of oils, such as the Sligh oxidation test and the Navy work factor method, are probably somewhat unsuited for predicting performance of an oil in an engine, as conditions are not sufficiently severe. The necessity for proper handling of oils after treatment in the refinery is stressed and factors to be avoided are noted.

Factors of importance in regard to the properties of the motor fuel used are: (1) Presence of high boiling point fractions which lead to dilution of lubricant and affect its carbon forming tendency. Incomplete vaporisation may also cause incomplete combustion due to unequal distribution to the cylinders, and this will tend to cause carbon deposits. Specifications normally include maximum 90% distillate temperatures to avoid this possibility. Volatility may also be lowered by polymerisation of volatile unsaturated compounds after refining. These changes may be indicated by a rise in E.P. or by a decrease in E.P., but an increase in distillation residue. Lowered volatility caused by gum formation not only increases the dilution of the lubricating oil, but is liable to cause ring sticking and to catalyse or hasten the oxidation of the lubricant, and thus further to increase its carbon forming tendency.

(2) Gum forming materials in gasoline may have a direct influence on carbon accumulation in the cylinder head as shown by Auld and by Gruse. They also cause deposits on intake valves and in the intake manifold, leading to valve sticking and finally to incomplete combustion of the fuel. Both of these factors are important sources of carbon formation. The effect of gum forming materials on the condition and operation of piston rings is being investigated by the writer.

Methods of handling cracked gasoline to avoid undue increase in gum content are discussed and the more general application of the oxygen bomb test as a guide to safe period of storage is advocated. Correlation between results of laboratory tests on gum content of gasoline and engine performance has not yet been achieved. Much work is being carried out on the standardisation of laboratory tests for preformed gum content of gasoline and the author is investigating the effect of the use of gum inhibitors with a view to obtaining a lower and more consistent results.

Worn engine parts and incorrect adjustments of the engine also play an important part in carbon formation, either by their effect on the lubricant or on the motor fuel. Consideration is given to a number of these factors.

R. A. E.

709. Automative Engines and Their Fuels. H. Wirshing. *Petr. World* (L. A.), 1933, **30** (3), 40–43.—This is mainly a review of the present day position of engine design in relation to available fuels, which falls under the following heads: (*a*) Discussion of engine efficiencies.—For practical calculations of cooling jackets, water-cooled manifolding, etc., the author takes the heat balance as 25% converted to work, 30% dissipated to jacket water, 25% loss in exhaust, 20% mechanical and unaccountable losses. (*b*) Fuels.—The Cetene method for Diesel fuels is described, and it is noted that the Otto cycle engine requires a fuel of high thermal stability, and the Diesel, low thermal stability. (*c*) Fuel Consumption.—It is pointed out that gasoline engines show a rapid fuel rate increase at diminishing loads. (*d*) Engine Design.—The value of Ricardo's work on the three stages of the injection engine combustion is pointed out. It is now known that the delay period is controlled almost entirely by the design of the combustion chamber and the chemical structure of the fuel. (*e*) Materials.—The author describes the improvement in mechanical properties of metal used for the various engine parts.

S. T. M.

710. "Oxidizing Agent" and Peroxide in an Otto Cycle Engine Cylinder. S. Steele. *Ind. Eng. Chem.*, Anal., 1933, **5**, 202–5.—This article describes experiments performed on the Ricardo E 35 variable compression engine to ascertain chemical changes taking place in the cylinder contents during various stages of the Otto cycle. Previously samples had been taken from the exhaust pipe, while the E 35 engine was rotated by motor at high jacket temperature, and aldehydes and peroxides had been detected. Experiments were performed on the engine delivering power, samples being taken from the cylinder. By means of a specially constructed valve, details of which are given, and which was screwed into one of the four standard spark plug holes in the engine cylinder, samples of the reaction mixture were accessible at various times. The opening and closing of the valve was actuated from the engine cam-shaft through a clutch by means of a push-rod. Qualitative tests on a straight run spirit performed on the compression stroke show presence of aldehydes, carbon dioxide and oxidising agent as detected by acid potassium iodide solution. Observations showed that the reaction between gas from the cylinder and the potassium iodide solution was slow, and it was therefore arranged for the gas to pass directly from the engine to the test solution and to remain in contact till the reaction ceased. Details of the arrangement are given. Quantitative tests on the compression stroke, exhaust and inlet strokes are appended. It was found that no trace of peroxide was indicated at any stage of the Otto cycle as evidenced by titanium sulphate solution through which gas from the cylinder was bubbled. Conclusions are drawn that the oxidising agent (possibly a nascent aldehyde) marks a definite stage in the progression of hydrocarbon air mixture to products of combustion. Graphs show: (1) that the oxidising agent concentration increases during the exhaust stroke; (2) reaches a maximum early in the inlet stroke; (3) and then decreases. With the engine running on benzole, a non-knocking fuel, there was a uniform increase in oxidising agent throughout the compression stroke. While running on gasoline the amount of "oxidising agent" remained constant. Complete absence of peroxide in the engine cylinder does not lend support to the Callendar peroxide theory of combustion and fuel knock in an engine.

R. E. D.

711. Bryce Fuel Injection Pump. Anon. *Auto. Eng.*, 1933, **23**, 171–2.—A description with sectional drawings and photographs of a new British injection pump. The pump is of the constant stroke variable by-pass type,

and consists essentially of a sleeve and plunger operated by a tappet reciprocated by cam and spring. The sleeve has two triangular ports, communicating with suction-side of pump and with the bore of the sleeve in which the plunger works. The plunger is drilled along its axis and has two holes at right angles to pierce the axial hole. The lower of these holes communicates with an annular groove in the plunger. The plunger can be turned about its longitudinal axis to vary the by-pass and so the pump delivery. The ports are arranged so that fuel is only delivered during the middle third of the stroke, thus providing a quick injection of the steepest part of the cam.

It is claimed that the common difficulty of properly filling the pump chamber at every stroke has been successfully overcome. A further claim is the elimination of plunger side thrust by hydraulic balancing. Various sizes of pumps are made covering a wide range of requirements. C. H. S.

712. Internal Combustion Exhaust Valve Failures. C. C. Hodgson. *Engineering*, 1933, **135**, 580–581.—A large number of valves have been examined after failure and conclusions drawn as to the reasons for this. Typical exhaust-valve steel analyses and photos. of valve failures are given.

In cases where the head breaks away from the stem near the region of highest temperature, it is found that the stem is cracked circumferentially. These cracks are roughly parallel to the main fracture, and appear to have their origin at oxide pits on the surface. The author's opinion is that these breakages are really a special case of corroaion-fatigue, the hot exhaust gases taking the place of the usual corrosion media. The best results may be expected from steels which are resistant to scaling—a view which is supported by service results. Inclusions in the surface may be the initial cause of the pits, or machining marks may have some connection.

Burning and cracking of seats probably constitutes the largest problem, and this type of failure is common to all kinds of steels used for exhaust valves. Leakage of exhaust gases seems to be the first stage. This may be due to distortion of valve or seating, lack of parallel motion of the valve, excessive wear, etc. Oxidation and scaling then start. Cracks in the scale then give rise to "heat-cracks" in the metal. Due to bad cooling (by conduction) of the oxidised part, the temperature of this portion of the valve may be as much as 200° C. above that of the remainder.

Very few materials (except Stellite and Mackalloy) have proved satisfactory for valve seatings. Trouble is experienced through metal being pulled from the seating by adhering to the valve. Blowing of gas then starts. "Picked up" material on the seating lead to irregular erosion. E. B. E.

713. Gasoline as Motor Fuel. I. Kimura. *J. Fuel Soc. Japan*, 1933, **12**, 41–43.—One-tenth of the gasoline used in Japan is of domestic production and attempts are being made to increase this proportion. Natural gas is being stripped of gasoline in absorption plants which are preferred to compression plants. The stripping oil is aromatic in nature with a sp. gr. of 0·83 and an end point of 255° C. Modern pipe-stills and cracking units are in operation to obtain the maximum yield of gasoline from the crude oil. The disagreeable odour of the cracked gasoline is eliminated by one of the following methods which are in commercial use. (1) The plumbite dilute sulphuric acid; (2) the methanol method of the Nippon Oil Co.; (3) the metallic salt of organic acids method of the Nippon Oil Co.; and (4) the ammonia method. G. R. N.

714. Fuel Alcohol. S. Hagiwara. *J. Fuel Soc., Japan*, 1933, **12**, 46–48.—The chief raw materials in Japan used in the production of fuel alcohol are sweet potatoes, maize and molasses, the last being the main source. Fuel

alcohol is denatured, duty free, and contains, for every 180 litres of 94% alcohol, 2 kilograms of approved petroleum distillate boiling below 280° C., 30 gms. formalin, 0·1 gm. of benzofast scarlet dye and 0·1 gm. rhodamine dye. Tests carried out on commercial engines show that the maximum compression ratio that can be used without causing detonation is 7·5 : 1 with this fuel. The range of percentage composition within which propagation of flame can occur is much wider in alcohol-air than in gasoline-air mixture, *i.e.*, 4–13% with alcohol as against 2–5% with gasoline so that with fuel alcohol the strength of the mixture can be varied within wider limits without causing misfiring. The theoretical quantity of air required for complete combustion being less for alcohol points to the necessity of providing an adequate air supply with a minimum amount of throttling when it is used. Engines using fuel alcohol give a smokeless and odourless exhaust and this is attributed to the lower carbon content of this fuel. It is necessary to preheat the alcohol-air mixture when starting the engine from cold. The calorific value of fuel alcohol per unit weight is much lower than that of gasoline and the fuel consumption per brake-horse-power-hour works out at about 363 gms. as against 263 gms. with gasoline. It has been stated that the products of combustion of fuel alcohol have a corrosive action on the engine but the author considers that this can be avoided by always using a full supply of air to ensure complete combustion or by adding a neutraliser such as ammonia to the fuel. In conclusion, it is suggested that since fuel alcohol is not readily inflammable, has no disagreeable smell, and gives smokeless combustion, it could be suitably used for various domestic purposes such as lamps, cooking furnaces, stoves, etc. G. R. N.

715. Tar Oil as Fuel. Anon. *Motor Transport*, 3.6.33, **56** (1473), 16.—In a paper read by F. A. Fitzpayne, at the Annual Conference of the Scottish Tramways and Transport Association, some results were given of the experimental running of a number of buses and lorries on tar oil.

This oil is obtained from tar made by high temperature (coke ovens), medium temperature (gas works), and low temperature carbonisation processes which in all produce about 400 million gallons of tar per annum.

The oil used as a motor fuel was blended from crude naphtha, light and middle oil fractions and had the following properties: Sp. Gr. at 15·5° C., 0·916; Closed Flash Point, 127° F.; Viscosity (Redwood) at 100° F., 29 secs.; Final Boiling Point, 245° C.

Some modification of engine design was found necessary when running on the new fuel, the carburettor especially, needing attention.

Lubrication of the engines at first presented some difficulties partly due to sludge formation, but this was overcome by the use of castor oil and more frequent drainage of the sump.

A comparison of the results obtained with tar oil and petrol showed that there was little difference in performance. There was, however, a saving on running costs when using tar oil which varied from 16–24%, depending on the vehicle under consideration. D. L. S.

716. A Theory of Fuel-Knock. S. Steele. *Nature*, 1933, **131**, 724–725.—It has been suggested that fuel knock in an automobile engine might be associated with the presence of free H_2 formed from the fuel, the assumption being that under knocking conditions the rate of reaction between this free H_2 and the available O_2 reaches a high order of magnitude.

Certain effects should be noticed, following this assumption, and in some cases evidence has been forthcoming of their existence. D. L. S.

717. Hydrocarbon Combustion in an Engine. A. Egerton and F. Ll. Smith. *Nature*, 1933, **131**, 725.—The gases at various moments during the cycle of an internal combustion engine have been sampled and examined for the presence of aldehydes and peroxides. There is evidence that the amount of peroxide formed is connected with the phenomenon of cracking.

It has been demonstrated that thallium let into an engine cylinder as vapour by a special valve is only effective when previously oxidised.

D. L. S.

718. Direct Recovery of Standard Road Tars from Vertical Retort, Coke Oven and Other Producing Plants. F. Cooke. *Gas World*, 1933, **98** (2544), Coking Section 50–56.—A process for the production of road tars from crude tar while using the tar as a cooling medium for the hot gases from ovens, retorts, etc., is described, and a diagram of a plant used for this purpose is shown. Tables are given showing analyses of tars produced by this method in comparison with the B.S.I. specifications. The advantages claimed are that labour charges are simply those for producing crude tar, and capital charges are almost negligible, since existing plant is utilised. The process can be applied to any system of carbonisation or any system of ammonia recovery in operation. Specific gravity and "free carbon" content of road tar produced are higher than for tar produced in stills from the same crude tar. Road tar and soft pitches of any desired consistency may be produced and tar dehydration plant is eliminated. A. O.

719. Composition of Sand Asphalt. J. Oberbach. *Bitumen*, 1933, **3**, 67–72.—Sand asphalt comes next to compressed asphalt in regard to durability, but it has the advantages of greater elasticity and better gripping power, while, in addition, it is cheaper. The sand used must be clean and free from colloidal material on its surface as moisture may by this means penetrate between the bitumen layer and the sand grains, causing disintegration of the surface. Best results are obtained with sand of which the grains are neither too round nor too angular and sharp. Dust should be absent. The nature of the sand is also important, as it has been found that different sands of the same surface and general grain and void characteristics require different proportions of bitumen. The size of grain is of fundamental importance in obtaining a satisfactory coating. The pioneer work of Richardson in this connection is briefly summarised. A surface for heavy traffic requires a larger proportion of the finest grade of sand. The larger sand grains do not form so dense a surface, while they are usually more rounded, and if present in too high a proportion tend to promote undulations in the surface. While this can be overcome by using hard bitumen, this, in its turn, is unsatisfactory owing to its tendency to crack, while in thin films at the high temperatures, oxidation may occur.

The New Jersey State Specification requires 11–12·5% of bitumen in the sand-asphalt, while the author has found that under other conditions a minimum of 9·5% is necessary.

Filler can only be used sparingly as an excess lowers the elasticity of the coating. The author finds that the amount of suitable filler (*i.e.*, material passing 200 mesh sieve) should not exceed 18%.

The adhesion between bitumen and mineral material plays an important part in the durability of the coat. A Kentucky natural sand-asphalt gave a good surface with 15% voids, whereas an artificial sand-asphalt with so high void content would rapidly disintegrate. In the natural product there is exceptionally good adhesion between the bitumen and mineral matter which can seldom be matched in the artificial material. C. C.

720. Down-Draught Carburation. H. Fisher. *Auto. Eng.*, 1933, **23**, 180–3.—The advantages and disadvantages of the now popular down-draught carburettor are dealt with in this article. The author is of opinion that it still remains to be seen whether this type of carburettor is merely a vagary of fashion or whether it marks a definite advance in design. He quotes the fact that the first American car to be so fitted has now returned to the orthodox "up-draught" type.

The importance of the design of manifold for use with a down-draught instrument is stressed, as many disappointing results have been experienced when due regard has not been paid to this problem. A larger choke can be used because the gravity effect on the fuel lessens the air velocity required at low speeds, but it is pointed out that low air-velocity and good atomisation do not go together, hence the need for very careful manifolding. The dangers of flooding and consequent oil dilution are dealt with.

In conclusion the author states that while it is easy to compare performances of different orthodox carburettors on the same manifold, this is not the case with down-draught instruments, where the manifold and carburettor must be considered as a whole, thus rendering true comparisons between carburettor performance alone a matter of impossibility. C. H. S.

721. Brick Pavements (Bituminous Fillers for). J. S. Crandell. *Surveyor*, 1933, **83** (2156), 520.—A paper, presented to the National Paving Brick Association of America describing tests on fillers for brick pavements, shows that most of the commonly employed jointing materials are defective in some respect. In materials containing fine mineral dust, the mineral settles to the bottom and since in most cases the manufacturer relies on the stiffening effect of the filler and uses a softer bitumen than is customary, the consequences are serious. In addition, such materials fail to reach the bottom of the joints when applied by the squeegee method to plain bricks, but give satisfactory penetration with lug bricks except in the case of the heaviest bitumen. It is suggested that the dipping method used with plain wood blocks, be tried in preference to the squeegee method or pouring from cans for brick paving.

All standard fillers of jointing materials were found to be brittle at freezing point, while three fillers which were not brittle did not conform to specification. Two of these contained rubber and the third was a pulverised asphalt softened with Maltha. Emulsions were not satisfactory for joints of new brick paving, but may be useful for filling joints of old pavements, the behaviour of emulsion-sand mixtures largely depends on quality and grain size of sand. When paving laid with bricks on beds of cut-back asphalts, or tars, mixed with river sand, was rolled, the cushions squeezed up into joints and almost filled them. This method is generally effective in ensuring that the lower parts of the joints are filled. A. O.

722. Emulsified Asphalt. V. L. Ostrander. *Quarry and Roadmaking*, 1933, **38** (437), 177–178.—Emulsified asphalt possesses a number of advantages over hot asphalt; it is easier to handle, eliminates damage due to overheating, application equipment is simple and inexpensive, and the binder is deposited at its final consistency. Emulsion can be used under weather conditions where work with hot asphalt is impracticable and the drying of aggregate is unnecessary. The penetrating property of emulsions permits of the use of a denser aggregate than is possible with hot asphalt, thus reducing the voids to a minimum and allowing a softer grade of bitumen to be used, the asphalt serving as an adhesive only. Roads prepared with emulsion give smooth-riding surfaces which are non-skid and non-bleeding, owing to the freedom from excess bitumen. A. O.

723. **Lubricating Greases.** H. S. Garlick. *Chem. Trade J.*, 1933, **92**, 236, 258.—The principal requirements of greases in general are an ability to flow under pressure with a minimum of "drag" through the pipes of the lubricating system, absence of separation of oil under sustained pressure, absence of "tracking" which allows a moving member to cut a permanent channel through the grease and an ability to remain at the temperature of the bearing without undue loss of consistency or decomposition. Attention to the requirements in particular applications has resulted in the production of many greases of special type.

In rolling mill practice an increase in the use of asphaltic bitumen as a hot-neck lubricant has been noted. Such a lubricant, however, has many disadvantages.

The use of an improved lubricant will show a decreased consumption of power, easier starting of the cold mill, longer life for the bearing brasses, and increased life of the lubricant.

In certain collieries the trucks have been equipped with modern bearings, and a central high pressure greasing plant installed. Remarkable increased efficiency and great economy has been reported.

Considerable work has been done on the development of better lubricants for the textile spinning industry. A completely saponifiable grease is required to ensure the removal of all grease with which the yarn has been accidentally contaminated during spinning. The consistency of the grease must be adjusted to the weight of the traveller, the speed with which it revolves round the ring, and the desired tension in the yarn. The grease must be suitable for use at temperatures of 90–110° F. and should exhibit no change in consistency within fairly wide temperature limits. Further, it should not give rise to hard deposits on the under side of the ring.

Grease lubrication is still rare in British locomotive practice, although in the U.S.A. much greater use has been made of the method. Grease lubrication and roller bearings have developed simultaneously to increase the efficiency of the modern locomotive. It has been demonstrated that the starting resistance of a roller bearing equipped coach is but 15% of that of a coach fitted with plain bearings, and it seems safe to predict that the roller bearing will play an increasingly important role in the future with the consequent demand of larger quantities of high-grade lubricating greases. Little development of grease lubrication has taken place in the marine world. A few vessels have been equipped with mechanical lubricators for supplying grease under pressure to the bearings. Economy of lubricant has been reported, but there appears to be a tendency towards increased bearing temperatures, and in some cases, increased wear of the bearing surfaces. The lubrication of the rocker arms on motor cycle and aero engines has resulted in considerable research on this problem. For motor cycles, a graphited grease appears to give most satisfaction, but in aero engines it is desirable that the grease shall be soft in order to avoid damage to the roller bearings. Moreover, it must be efficient over a temperature range of 0° F. to 350° F., and show no tendency to gum or carbonise. It must be water resistant and be able to withstand the continuous pounding of the push rods without breaking down. Aluminium greases provide the best solution up to date. Their peculiar property of increasing in consistency between 100° F. and 250° F. makes them especially suitable. In particular, they resist the tendency to flow off except at temperatures above 300° F. A disadvantage is their tendency to hydrolyse with the separation of flocculent aluminium hydroxide. The United States Air Corps has issued a specification (E-100) for rocker arm lubricants calling for a homogeneous mixture of mineral oil with at least 15% aluminium stearate or palmitate, and an A.S.T.M. penetration of 300–360.

Greases for automobile lubrication are usually lime soap cup greases containing an oil of at least 200 sec. viscosity Say. at 100° F., and a minimum soap content. The best types have low ash and moisture contents and a wide range of application. In this country, oil is still the usual gear-box lubricant, although greases have been used with complete success. Lead soap base greases appear to be most effective in withstanding the high pressures obtaining. It appears that the effectiveness of the grease is increased if its sulphur content is somewhat in excess of that of the oil proper. With regard to grease making technique, little progress has been made with the adoption of the high pressure kettle. Most manufacturers use the "cold" process for lime-soap greases. Increased attention to stirrer design and temperature control is becoming evident. Metal containers are displacing wooden barrels for grease distribution. This makes for cleaner handling and storage, and obviates the loss of oil by its soaking into the wood. H. G.

724. Carbon Removal Important Requirement of Top Cylinder Lubricants. D. H. Foster. *Nat. Petr. News*, 12.4.33, **25** (15), 66.—Most of the wear in an internal combustion engine takes place near the top of the cylinder walls due to unavoidably imperfect lubrication. Valve guides suffer excessive wear from the same cause. Some lubricating oil finds its way to the piston head and to the top of the valve guides where, especially in the exhaust valve, carbonisation occurs. The use of a top-cylinder lubricant is, therefore, advocated, but it is pointed out that such a lubricant must be capable of softening and removing the deposit which is responsible for much of the wear. It is claimed that a suitable lubricant has been prepared, by a special process, from a high gravity Mid-Continent crude and that the results of practical tests have exceeded expectations. H. G.

ABSTRACTS.

Class 100. Geographic Occurrence.

725. Report on Alberta Oil Industry. Anon. *Petr. World*, 1933, **30**, 160.—An outline of the annual report of the Alberta Department of Lands and Mines for 1932, mentioning the data recorded in the Turner Valley conservation, and stating that 9159 geological samples recovered during drilling were examined. Special visits were made to many of the locations of abandoned wells. Out of a total of 1801 inspections carried out in the Peace River area, 842 were special cases arising from water shut-off tests or the necessity of controlling faulty drilling work. Before the advent of Government control of wells it was the practice of operators to drill to the oil horizon with a minimum amount of casing and no efficient cementation. This resulted in the majority of the wells showing an excessive amount of water which had to be removed with the oil from the well. The oil in the latest wells drilled under Government specification and supervision is practically water free, and proves definitely that the mid-Alberta heavy crude oil areas can be relied on to produce crude oil free from water. Government supervision has also resulted in converting gas-producing wells which showed excessive quantities of water into dry wells in the Medicine Hat gas field, by having repairs carried out on defective casing and cementation, thus contradicting the general opinion previously held that the excessive quantity of water was encroaching water due to gas depletion.

During the year, development in the Province has been handicapped by the world depression and the large stocks of oil held in storage in other oil-producing countries, the effect of the latter being to reduce the market value of all oil produced locally. Latterly the rates paid at Alberta wells have slightly increased, and this may be an indication of a general improvement from which a renewed interest in the oil and gas potentialities of the Province may be expected.

The depression had the effect of stopping all new and other developments in the Wainwright, Ribstone, Skiff and Red Coulee areas. This, combined with the drilling restrictions in the Turner Valley, has resulted in the gross annual output of oil being considerably below that for the same period of the previous year. Annual production for fiscal years was:—1930–31, 1,614,202 brls.; 1931–32, 1,246,328 brls. A further and possibly marked decline in the provincial production may be anticipated for the forthcoming year when, owing to the projected conservation restrictions in the Turner Valley, it is anticipated that the gross output of oil for all the Province will not exceed 720,000 brls.

In the past, the development work in Alberta has been considerably handicapped on account of high drilling costs which unfortunately resulted from the intensive drilling campaign in the Turner Valley, rates of wages and prices of supplies and commodities being increased to high values, which reacted in retarding development in other areas. There are many indications that these rates cannot any longer prevail, and it is anticipated that, with a return to normal prices, considerable new prospecting will be initiated in the near future. The production of crude oil within the Province being insufficient for provincial requirements, there has to be imported annually over 1,200,000 brls. of crude oil for use in the local refineries.

W. W.

726. Trinidad's Petroleum Industry. Anon. *Petr. Times*, 27.5.33, **29**, 543.—Official review for 1932 by the Inspector of Mines. The production during 1932 was the highest yet recorded, viz.:—10,126,065 brls. compared

with 9,743,502 for the previous year. Petroleum products and asphalt formed 56·80% and 3·14% respectively, of the total exports of the mineral industry of the Colony.

In common with other industries the oil industry of the Colony suffered from the financial conditions which are prevailing throughout the world.

During the period under review drilling operations have been further curtailed in that only 173,287 ft. were drilled compared with 218,642 ft. in 1931 and 372,530 ft. in 1930.

Volume and value of petroleum products exported :—1932, 9,637,474 brls. valued at £2,382,846 ; 1931, 8,964,304 brls. valued at £1,949,455.

At Point Fortin the new refinery, having a capacity of 1000 tons of crude oil/24 hours, was nearing completion at the time the report was made out, and the construction of a pier some 8500 ft. long at which vessels drawing 30 ft. of water will be able to load is now in progress. It is expected the pier will be completed during the year.

The Kern Trinidad Oilfields, Ltd., has also commenced the erection of a refinery designed to treat 1000 brls. of oil/24 hours.

During the year 61 wells were drilled, of which 41 were on Crown lands and 20 on private lands, an increase of one as compared with 1931. In 46 of these oil was struck. The total number of wells drilled in the Colony to December 31st, 1932, was 1902, of which 1197 were on Crown lands.

At the close of the year 16 concerns were actively engaged in the winning of oil, as against 14 at the end of 1931. A list of oil companies established in the Colony is given. W. W.

727. Petroleum Development in Germany During 1932. W. Kauenhowen. *Petr. Times*, 27.5.33, **29**, 561.—Developments in the Oelheim-Eddesse Field from the year 1881, and the method of production in the Volkenroda Field, are summarised.

More than 10 new salt domes, with depths up to 3280 ft. or more, are reported to have been found during 1932 by seismic and gravitational methods in the western part of the North German plain. Altogether more than 25 geophysically discovered salt dome prospects are known in this region, and of these two have been proved by drilling. Extensive torsion balance surveys were made during the year by various companies in the Northern plains to discover new salt domes and to outline known plugs. Magnetic surveys were made in the Thuringia and Danube basins to locate regional features of the basement rocks. Electrical investigations have been carried out in the salt dome and Thuringian territory to solve local problems.

During 1932 about 15 wildcat wells were completed in Germany.

There are 35 petroleum refineries with a total capacity of about 15,000,000 brls./year. Only a few of these can handle German crude oils, and hence a distinctly forward step was made in 1932, when a modern Dubbs cracking plant was completed at Misburg, near Hanover.

The article concludes with a few notes on taxes and legislation. W. W.

728. Mineral Oil Refining in Great Britain, 1932. *Oil and Colour Trades J.*, 1933, **83**, 1736–7.—This article shows tables, compiled from the Customs Trade Returns and from information supplied by the oil companies, which indicate the throughputs and outputs of home refineries, the imports of crude petroleum from various sources, and imports and home production of motor spirit, kerosine, gas oil, lubricating oil, fuel and diesel oils. The period covered is from 1929 to 1932, whilst some tables include in addition statistics for 1927 and 1928.

Noteworthy features for the year 1932 are as follows : (1) slightly increased imports of crude over 1931, but a decrease in throughput of the refineries of 12%. This is reflected in a decreased production of all products except lubricating oils ; (2) retained home production of motor spirit represented 11·9% of the total home requirement in 1932, as against 15% in 1931. A decrease is observed for all grades of oil in this respect. W. E. J. B.

729. **Neftedag**—"**The Oil Mountain.**" I. M. Gubkin. *Oil News*, 1933, **33**, 476–7.—Neftedag is situated to the south of the Central Asiatic Railway and is connected thereto by a 72 kilometre siding. Surrounding Neftedag are salt marshes which, until comparatively recent times, formed the bottom of the Caspian Sea. The mountain is an anticlinal dome-shaped fold with its axis from S.W. to N.E. This fold is intersected by terraces, one of which divides the entire area into two almost equal parts, northern and southern. Oil research, originally conducted in the oil sands of the Apsheron layer, was extended to the Akchagyl layer consisting of pink and greenish clay deposits, about 60–70 metres thick ; and finally the red layer, closely similar to the so-called producing stratum of the Baku area, was investigated. Wells Nos. 12 and 13 established the oil-producing capabilities of this layer, and confirmed Kalitzky's predictions. Further productive horizons may yet be found.

The author gives an historical summary of research work carried out in the region, and records that Well No. 13, on its second drilling, gave at 440 metres not less than 100,000 tons of oil in 20 days. The estimated reserves of the whole area of Neftedag, based only on the red layer, are given as approximately 10 million tons, and it is considered possible that the U.S.S.R. may find the whole province to be oil-bearing. W. E. J. B.

Class 200. Geology and Origin.

730. **Geology of Petroleum.** V. C. Illing. *J. Inst. Petr. Techn.*, 1933, **19**, 427–36.—A survey of the literature published during 1932 on the geology of petroleum. G. R. N.

731. **Geophysics.** O. Weiss. *J. Inst. Petr. Techn.*, 1933, **19**, 437–447.—An analysis of the developments of the last three years in methods and instruments used in geophysics and a survey of future possibilities. G. R. N.

Class 300. Development and Production.

732. **Field Technology.** *J. Inst. Petr. Techn.*, 1933, **19**, 448–496.—This covers the 1932 reports on : (1) Rotary Drilling, by R. Harcus ; (2) Rotary Drilling Mud, by A. Reid ; (3) Water Location during Drilling, by A. Reid ; (4) Cable Tool Drilling ; (5) Well Equipment, by W. Wade ; (6) Cement, by A. Reid ; (8) Well Surveying, by P. Evans ; (9) Power ; (10) Gas Lift Methods, by L. W. Rogers ; (11) Flowing Methods ; (12) Care of Wells, by C. Thomas ; (13) Well Surveying, by D. Comins ; (14) Gas and Oil Separation, by G. McConnell ; (15) Water and Oil Separation ; (16) Gas Treatment, by V. V. Jacomini ; (17) Oil Mining, by A. Pelissier ; (18) Pipe Lines, by A. C. Hartley ; (19) Tank Steamers, by D. H. Jackson ; (20) Natural Gas Transport, by A. C. Hartley ; (21) Storage, by A. C. Hartley ; (22) Oil Measurement ; and 23) Fire Prevention and Fire Fighting. G. R. N.

733. Deep Drilling Practice. W. A. Sawdon. *Petr. Eng. Mid-year*, 1933, **4** (9), 28.—The present trend in drilling practice is towards the better adaptation of the materials and equipment already available. The results obtained during the year have shown that the available equipment has been developed by manufacturers to a point beyond present requirements.

The 136-foot derrick has replaced the 122-foot one because of the additional space available. The additional height enables faster speeds to be used and the larger base provides more space for additional stands of pipe and for the larger rig equipment.

Foundations and cellar construction have been given considerable attention, and in certain places cellars are being eliminated.

Steam and electric power are still being used in about the same proportions as during the previous few years. The use of superheated steam is on the increase in California and temperatures have been considerably increased.

Drill pipe has not undergone any change in construction and has proved satisfactory in the drilling of the record depths in California.

All types of bits have been used to advantage.

No general casing scheme can be followed for the entire state since conditions vary widely. Flush joint casing was used for the two lower strings in a Kettleman Middle Dome Well.

Surveys carried out whilst the well is being drilled have aided in keeping the deviation to a minimum. Weight control and speed of drilling are treated with varying importance.

There has been an increase in the use of formation testers for making water shut-off tests in California, and the results obtained indicate their advantage over the old bailing method.

A more judicious use of admixture shows the importance attached to drilling muds, and rotating screens have proved their value. L. V. W. C.

734. Drilling Advancements. K. C. Sclater. *Petr. Eng. Midyear*, 1933, **4** (9), 60.—During last year valuable work has been done on pressure control completion methods in high-pressure fields with hydraulic rotary equipment.

Due to the high-pressure conditions encountered in the Big Lake Field, Texas, a modification of the drilling-in methods was necessary (*c.f.* Abstract No. 514).

As a means to obtain economics in drilling with steam power, a vertical steam drilling engine has been developed. This steam engine in which the steam is used expansively makes possible for the first time the use of only one prime mover for hoisting, rotating and mud circulation.

More attention has been paid to the control of drilling fluids to obtain greater drilling efficiency as drilling depths increase (*c.f.* Abstract No. 520).

An innovation in cementing practice is the multiple stage system. By means of this system it is possible to overcome the difficulties arising from the high temperatures existing at the bottom of the deep wells.

Investigations of drill-pipe stresses have been carried under actual drilling conditions and some interesting results have been obtained (*c.f.* Abstract No. 516). L. V. W. C.

735. Diesel Engine for Slush Pump Drive. *Engineering*, 2.6.33, **135**, 594.—The engine used in this installation is a 260 b.h.p. 6-cyl. (each 7½ in. bore by 12 in. stroke) Diesel, developing the rated output at 750 r.p.m. and weighing about 40 lb./h.p. The engine drives, through a friction clutch and flexible coupling, a shaft on which a Tex-Rope pulley is mounted on roller bearings, the pulley incorporating a dog clutch, so that it can be driven from the shaft when the clutch is engaged, and remains stationary when the clutch is disengaged. A second shaft, on which a Tex-Rope pulley is keyed, is driven

from the end of the first shaft through another dog clutch. By operating the two dog-clutches, it is thus possible to drive either of the pulleys at will.

The Tex-Rope pulleys on the engine-driven shafts are about 15½ in. in diameter, and each carries 14 Tex-Ropes which pass round pulleys 64 in. in diameter on the pump countershafts. The distance between the countershaft and engine-shaft centres is 6 ft. 11 in. with provision for adjustment to take up slack in the ropes. Pump countershaft speed 181 r.p.m., pump crankshaft speed 41 r.p.m.

Each of the two pumps, 14¼ in. and 7¾ in. by 18 in. stroke, absorbs 200 h.p. when working at full capacity. With 7¾ in. bore liners the discharge capacity is 374 imp. gal./min. against a pressure of 500 lb./sq. in. and with 4½ in. bore liners 103 imp. gal./min. against a pressure of 1750 lb./sq. in.

On test at makers' works the engine gave a fuel consumption of 0·378 lb./b.h.p. hr. when developing the full load of 260 b.h.p. at 750 r.p.m. and at the same speed, with an overload of 273 b.h.p., the fuel consumption was 0·374 lb./b.h.p. hr. The installation has been in service in Burma for some twelve months and has given complete satisfaction to the purchasers.

W. W.

736. Direct Current for Rotary Drilling. W. C. Lane. *Petr. Eng.*, June, 1933, **4** (10), 49.—Since the power required for drilling must be applied at a variable speed, it is necessary to be able to change quickly both the speed and the torque of the drilling and hoisting motor throughout a wide range, with small increments and to reverse the direction of rotation.

Where electricity is the power being used, this can be accomplished by using the system developed by Ward Leonard.

When this system is applied to a string of rotary tools, the simplest combination would consist of two main generators and one small unit known as the exciter. The generators can be driven from any combination of engines.

A plan of the basic connections and the characteristics of hoist motors now in service are given.

L. V. W. C.

737. Chemical Injection in Kansas Wells Retards Corrosion Action. Anon. *Oil Weekly*, 3.7.33, **70** (3), 22.—Difficulty is experienced in one of the Kansas Fields through the presence of hydrogen sulphide and a low concentration of salt in the water coming with the oil from the deep producing horizons. Continued pulling of tubing, casing, etc., has been necessary since the oil was discovered in that region.

An attempt was made to manufacture some alloy which would not be attacked, but these measures failed, and chemicals which could be injected into the hole were then studied.

Caustic is the base of the treating compound used. Other chemicals, which are colloids, are added, depending upon the individual well and the intensity of corrosion.

The application of the chemicals may be made in three ways—manual, operation through beam connections, and where central pumping powers are being operated the mechanism is connected to the rod lines.

Where the well is being pumped 24 hours the chemical is inserted continuously in small quantities.

Each well is a problem in itself, but only four or five general classes of corrosion and scale-forming problems present themselves. Which form of chemical is to be fed to the wells must be determined by the chemist after an analysis of the water and hydrogen sulphide content of the oil.

L. V. W. C.

738. Testing Water Shut Off. Anon. *Oil Weekly*, 3.7.33, **70** (3), 28.—The hydrostatic head created by a fluid column left in a hole is often sufficient to effect the flow from the formation at the shoe, and a well which appears to be dry on a bailing shut-off test may later show a tendency to produce water because of a faulty shut-off.

Casing testers have been used for testing water shut-offs in the Ventura Avenue field at depths and under conditions which would make bailing tests difficult.

Packer type casing testers have been run on drill pipe and the packers set a short distance above the shoe of the string being tested. The nature of the flow has been determined by a calculation of the quantity of fluid trapped in the hole below the packer after the amount originally in the hole has entered the drill stem. L. V. W. C.

739. Desirable Characteristics Retained in Heavy Drilling Muds. Anon. *Petr. Eng., Midyear*, 1933, **4** (9), 72.—In the majority of cases where rotary drilled wells in the deep high pressure areas get out of hand, the cause can be traced to improper drilling mud. A drilling mud has certain well-known duties to perform and should be capable of carrying out these duties if it is to be deemed a good drilling mud.

One fluid, which has as its principle ingredient amorphous iron oxide, maintains its viscosity and colloidal properties at heavy weights up to 150 lb per cu. ft. L. V. W. C.

740. Shooting a Well with Liquid Oxygen. *Daily Oil Bulletin*, 19.6.33 (4714), 3.—In August, 1932, the European Gas and Electric Company spudded in a well for gas at Aichkirchen, near Lambach, Upper Austria, which by April, 1933, had reached a depth of 700 metres.

As only small quantities of gas were met with, it was decided to abandon the well and to recover at least 60 metres of the casing. Attempts to cut the casing at a depth of 60 metres with the usual apparatus having failed, it was determined to shoot.

The shooting was carried out on April 29, 1933, with liquid oxygen. An explosion was required comparable to that of 10 kg. of 65% gelatine dynamite. Eight explosion cartridges, 300 by 80 mm. Wiethuchter system, were provided. To saturate these cartridges 15 litres of liquid oxygen was required. The eight cartridges were placed in a cylindrical container of tin. The bore-hole was pumped full of mud; and the charge, under a suitable weight of iron, was detonated by electricity at 70 metres, whereupon a column of mud about 10 metres in height indicated a successful explosion. The upper lengths of casing were propelled upwards, by the shot, about 30 cm., and could be easily withdrawn.

The use of liquid oxygen was decided upon because the transport of the necessary small quantity of dynamite would have been costly and troublesome. Further, the use of dynamite was not possible, as the shooting had to be carried out within 24 hours of the placing of the order in Vienna. Liquid oxygen can be transported without special precautions. The manipulation of the apparatus is unusually simple, and special precautions to preserve the cartridges from damp are not necessary. However, it may be remarked that the mud, in which the charge was detonated, has a temperature of about 40° C. (104° F.).

This is the first shooting of a well in Austria, and the first carried out with liquid oxygen. W. W.

741. Some Principles of Fluid Flow. W. C. Edmister. *Petr. Eng*, June, 1933 **4** (10), 51.—This article is an explanation of a fluid flow chart developed by the author. L. V. W. C.

742. All Steel Rig Front Fabricated in Field. Anon. *Oil Weekly*, 3.7.33, **70** (3), 26.—A description is given of a field-fabricated all-steel rig, designed for pumping and pulling rods and tubing. L. V. W. C.

743. Pumping Equipment and Methods in East Texas. K. C. Sclater. *Petr. Eng.*, June, 1933, **4** (10), 68.—Many wells in the East Texas Field are now being equipped for pumping and central power units are being used in large numbers.

Geared power pumping units of a variety of types, such as the one-speed type, the crank equipped heavy duty unit, and the double crank overpull type, are being installed.

Large bandwheel powers are also in course of installation in the field. The pull rod connections are of ample strength to handle any wells that may be put in the power.

The pumping jacks and pull rod equipment are of steel construction, and every precaution is taken to reduce friction and lost motion by correct installation of the rod line posts and the careful laying out of pull rod lines.

Individual pumping units are being installed in certain districts.

The low daily well production allowed under proration regulations has brought about the use of back cranks. In these installations a pull rod connection is attached to a back crank on the well at which the prime mover is installed and from it one or two additional wells are pumped by jack.

Artificial lifting has been tried in an effort to lower lifting costs.

Most pulling and cleaning out equipment is of the portable type, but individual well pulling equipment is expected to come into wide use later.

The methods of transporting the oil from the well to the storage tanks vary in different parts of the field. L. V. W. C.

744. Economy in Auxiliary Stand-by Unit. F. B. Taylor, Jr. *Petr. Eng.*, June, 1933, **4** (10), 17.—The ordinary standard pumping equipment has recently been supplemented in many instances, by a small stand-by unit of the gasoline motor type. This unit will give an additional security against shut down.

An ordinary motor of the automobile, tractor or truck type can be used by making the necessary small alterations and additions. Automatic control is desirable and can be obtained by the use of the conventional fly-ball governor. L. V. W. C.

745. Sucker and Pull Rods. C. L. Shirley. *Oil & Gas J.*, 22.6.33, **32** (5), 49.—The joints used on sucker and pull rods are of two types: (1) box and pin joint, and (2) double pin and coupling type joint with couplings.

These joints have their advantages and disadvantages, and selection of a particular type should be carefully considered.

Loads and stresses will determine the dimensions of the rods.

Tables are given of the performance of a number of strings and of the percentage of larger size rods to be used in a combination string.

The useful economic life of the rods can be increased by care and attention to details in handling. L. V. W. C.

746. Solving Well-Pumping Equipment Problems. H. Ledeen. *Petr. Eng.*, June, 1933 **4** (10), 84.—This article deals with the type of prime mover most suitable for operating the pump, which is to lift the oil to the surface. L. V. W. C.

747. Slow Pumping Equipment. B. Mills. *Oil Weekly*, 3.7.33, **70** (3), 20.—Slow-speed pumping has proved itself of value where it has been found impractical to pump wells full time at regular speeds. Reduction in power costs and elimination of excessive wear and tear have been noticeable.

In a number of cases the large electric motor formerly used has been disconnected and now serves as a counter-shaft and the new power is transmitted through the large unit by a small motor of from 1½ to 3 horse-power. In one type a large sprocket wheel has been attached to one end of the large motor and two belts have been used in the installation. One belt connects the larger motor pulley and the large pulley on the counter-shaft, and the other runs from the small pulley of the counter-shaft to the band wheel.

Another type of slow pumping apparatus consists of a large cylinder which stands directly over the well. A gear-type pump, operated by a small electric motor moves the liquid in the lower part of the chamber. The upper part of the outer chamber is under air pressure. The fluid in the lower part of the outer chamber is moved, at any desired speed, to operate the rod string.

L. V. W. C.

748. Handling Cooling Water. Anon. *Oil Weekly*, 26.6.33, **70** (2), 23.—The provision of cooling water for gas engines employed at pumping wells in the Signal Hill Field, is difficult on account of the lack of space for placing the water tanks. This difficulty has been overcome by the installation of a distributor in the end of the discharge line from the cylinder jacket. This distributor causes the water to split up into a spray, thus cooling it.

L. V. W. C.

749. Rodless Pumping Units. Anon. *Oil & Gas J.*, 22.6.33, **32** (5), 74.—This article gives a brief account of the many new systems which have been developed for the lifting of the oil to the surface without the use of sucker rods.

Such systems as the plunger lift, the Reda reciprocating pump, which is installed on the end of the tubing, stage lift, siphon lift and venturi tube, bottom-hole choke principle applied to new gas lift and kick-off collars are dealt with.

L. V. W. C.

750. Application of Pneumatic Cylinders to Pumping Wells. H. B. Thomson. *Oil & Gas J.*, 22.6.33, **32** (5), 68.—The system of pumping wells by pneumatic cylinders consists of a central compression plant, high pressure outgoing and low pressure return pipe-lines and pneumatic cylinders suspended in the derricks over the wells.

To compensate for any loss or leakage of air or gas from the pipe lines and cylinders, a small make-up compressor is installed. A small tubular heater is installed at the well to preheat the air and so reduce compressor requirements for pumping.

The operation of the plant is fully described and a schematic drawing is supplied to explain the various parts used.

The performance of this system clearly shows that a new method of pumping is available which permits the operation of wells at speeds commensurate with their productions. In addition, there is a reduction in stress on sucker rods and wear in sub-surface equipment.

L. V. W. C.

751. Gas Lift Intermitter Meets Conditions at Oklahoma City. Anon. *Oil Weekly*, 10.6.33, **70** (1), 17.—A gas lift intermitter which eliminates undesirable features of the water-operated type has recently been designed and operated in the Oklahoma City pool.

The design consists essentially of two balanced valves, two needle valves, a modified regulator and a specially designed arrangement for kick-over control.

Gas at about 500 lb./sq. in. is fed into a small reserve tank and furnishes the necessary pressure for operating the mechanism.

The gas enters the space above the diaphragm and builds up pressure. When this pressure overcomes that exerted by the steel balls seated in the lower groove on the piston, the diaphragm drops and the balls seat into the upper groove. At the same time the hole through which gas bleeds when the second well is not being operated is now covered by packing and seals off the space beneath the diaphragm.

An horizontal lever now drops and closes the mud valve to well No. 2, and opens inlet valve to well No. 1. At the same time the exhaust port for well No. 2 is freed and the gas is bled from the upper portion of the diaphragm. L. V. W. C.

752. Gas Lift Operations. S. F. Shaw. *Petr. Eng. Midyear*, 1933, **4** (9), 46.—Continuous flowing by gas lift has been used to a much less extent than previously, although in some parts of the world good results are still being obtained. Its chief application is on wells making large productions, although the method can be used on small wells.

In wells having small yields small flow strings have been advocated, and tapered strings have shown good results in a number of cases.

Where high starting pressures prevail a number of starting valves have been tried out, and although objections to their installation can be found, the use of such valves would appear to be a step in the right direction.

In the East Texas field pumps are being installed, in most cases for handling wells that have ceased to flow. The author suggests that the intermittent method of gas lift could be employed satisfactorily in this field. This system has been found advantageous in small wells in fields where the reservoir pressure has declined to a low point.

Intermittent gas lift may be conducted with or without bottom-hole chamber. The latter method is used for flowing wells of 150 brl. and upwards in fields of 4000 ft. or more in depth. A large number of these intermitters are now available.

Surface chokes and bottom-hole chokes have received considerable attention in connection with the flowing of wells, both naturally and on gas lift.

The methods for taking bottom-hole pressures have been improved and the knowledge gained is important in determining the best manner in which to flow wells. L. V. W. C.

753. Air-Gas Lifts. Anon. *Oil & Gas J.*, 22.6.33, **32** (5), 55.—No special problems are involved in the application of gas lift to East Texas wells. During the period between cessation of natural flow and the introduction of mechanical production equipment, it is usually necessary to agitate the wells by some mechanical means to lighten the fluid column and so enable the well to deliver its allowable quantity. Instead of agitating the wells, a number of operators are to use gas as a kick-off medium.

Detailed data will be necessary before the air-gas lift can be installed, but past practice in other fields will be followed by those required to make recommendations as to the methods to be introduced when the natural flowing life ceases. L. V. W. C.

754. Cleaning Out Wells. Anon. *Oil & Gas J.*, 22.6.33, **32** (5), 60.—The deposition of paraffin in tubing may be ascribed to three major causes: (1) Temperature drop in the oil, (2) loss of volatile constituents, and (3) foreign matter.

In order to prevent the precipitation of paraffin the temperature must be maintained at a sufficiently high level to keep it in solution. If precipitation cannot be prevented high velocity is essential. Maintenance of constant low gas-oil ratio will assist in keeping the temperature at the proper level.

Faulty connections at the surface should be avoided if volatile constituents are to be retained.

In all except completely plugged tubing strings mechanical scrapers can be used. Where the string is badly plugged chemicals must be resorted to.

Tubing should be arranged so that the sand cannot be uncovered and conductors should be keep full of oil at all times where possible L. V. W. C.

755. Production Practice. K. C. Sclater. *Petr. Eng. Midyear*, 1933, **4** (9), 10.—Great progress has been made in many phases of production practice during the past year. The selective solubility of gas and oil in its relation to production, the application of direct sub-surface measurements as an aid to the control of production operations, bottom-hole choking, the mechanics of central pumping power systems, acid treatment of wells and the installation and design of pumping systems have received serious attention.

L. V. W. C.

756. Production Methods in California. C. L. Moore. *Petr. Eng. Midyear*, 1933, **4** (9), 34.—The economic uncertainty has retarded the development of new production methods. The adoption of slow speed pumping or critical speed pumping has continued and a large number of wells equipped with direct motor driven reduction gears have been slowed down to their critical pumping speeds by installing small squirrel-cage motors on top of the existing motor. By this means speeds as low as 3 strokes per min. may be obtained.

The installation of band-wheel units and flow units continued at a lower rate.

Curtailment programmes practised in certain fields in California have given an impetus to operators to study sub-surface conditions.

The methods of handling oil from the well to the shipping line have been studied, and the use of gravity type oil meters for measuring and sampling the flow from individual wells is rapidly increasing.

Emulsions are common when edge water appears in the wells and the lowering of the speed of pumping has done much to reduce and, in some cases, eliminate entirely such emulsions.

Automatic bleeders operated by means of photo-electric cells have been developed to remove free water from settling tanks. L. V. W. C.

757. Gathering East Texas Crude Oil. W. L. Baker. *Petr. Eng.*, June, 1933, **4** (10), 79.—Locations for tanks in the East Texas field are carefully selected. Ample provision is made for drainage and filled ground is avoided to prevent settlement. The base plate of the tank is protected from corrosion by placing the tank in a foundation of compacted oil sand.

All gas-tight and water-seal tank roofs are provided with relief valves, set to operate at predetermined pressures.

Gas from the stock tanks is vented through a common vent line and burned, and to prevent a return of the torch flame a safety screen is placed in the riser.

The most common header manifold is of 4 in. pipe and in many cases it is so arranged that a paraffin scraper may be inserted to clean the lines.

Such methods as the use of chemicals, gas agitation, or gun barrel separators are being used to reduce paraffin deposition.

Careful surveys of the areas over which the pipe lines are to be run enable most of the production to be gathered by gravitation.

Pumping units are of the reciprocating or centrifugal type.

Gauging methods are important and the average of three gauges is taken. An average sample of bottom settlings is also tested at 100° F.

L. V. W. C.

758. Loose Sand Fields Require Different Proration Procedure. J. O. Lewis and H. F. Wright. *Oil & Gas J.*, 15.6.33, **32** (4), 16.—In general pools can be divided into two groups from a proration point of view. The distinctions between the two are in the ease of flow through the reservoir rock and the source of pressure.

In a field where gas is the predominant force it is expected that, in the main, the drainage area underground can be kept substantially equal in area to the surface ownership. The area marks the outlines of highest pressures between the wells and their offsets and within this area the gas and oil flow inwards to the wells. Whilst this condition maintains the property is obtaining its share of the supply.

If the predominant force is not associated with the oil in the property this principle of control no longer holds.

Where the force is predominantly hydraulic a wall of high pressures cannot be built around the property and the oil cannot be caused to flow inward from that drainage line.

The rate of production almost always determines under which control the field is maintained and, since in all but the exceptional field the original gas pressure is equal to the hydrostatic pressure, any rate of production will reduce the pressures around the producing wells below the gas pressure so that gas becomes the predominant force.

Curtailment of production has given new information on this subject.

In the suggested method of prorating the acreage is directly included as a factor and averages are taken for groups of properties instead of dealing with each property separately.

The facts upon which proration would be based are: 1. Allowable production; 2. Bottom hole pressure; 3. Legal production; and 4. Proved acreage.

L. V. W. C.

759. Comparative Data on Bottom-Hole Pressure in Seminole. S. F. Shaw. *Oil & Gas J.*, 8.6.33, **32** (3), 20.—From a study of bottom-hole flowing pressures carried out in the Seminole Field, it was found that the maximum daily production, within certain limits, depends upon the diameter of the flow string, particularly in the early life of the well.

It was found also that the smaller the diameter of the flow pipe the greater will be the flowing pressure, at the bottom of the tubing, required to lift the oil at a given rate of production.

The effect of increasing back pressures was also investigated and a graph is given showing the results.

Various tests have indicated that in most wells a critical flowing pressure is reached, below which there will be no increase in the production of oil if no change is made in the tubing and casing diameters.

Various deductions can be drawn from the construction of bottom-hole flowing pressure graphs, but it must be understood that they can only be used for the particular area from which the information was obtained.

L. V. W. C.

760. Intermittent Application of Pressure for Drive Suggested. E. G. Woodruff. *Oil & Gas J.*, 8.6.33, **32** (3), 13.—In the ordinary method of repressuring large quantities of oil will be by-passed, due to the different

rates of action in the different parts of the sand bed. The flow will be rapid in some parts and slow in others.

High intake pressures will force oil from the coarse sands, but will have little effect upon the tight portions. On the other hand, low intake pressures will not force oil through the coarse sands but will drive slowly into all parts of the sand.

The medium-grained areas of the sand will not be affected by high pressure over a short time or by low pressure over a long time, since the pressure is constant. This constant pressure will build up a pressure in these areas which does no work, since movement of oil can only take place when a differential pressure exists.

A reserve pressure is thus built up, and any lowering of input pressure will enable this reserve force to act.

Any change in pressure throughout the sand body alters the position of the oil in the interstices.

It is suggested, therefore, that a pulsating action, that is, a higher pressure for a period, then a lower pressure for a time, then a reverse, should be used in actual practice. Sufficient time should be allowed to build up pressure and to relieve it.

The effect of such a system would be to build up pressure in all parts of the sand and to saturate the oil with gas under high pressures, and to develop a condition, even in the tighter parts of the sand, with forces sufficient to drive out the oil if these forces are permitted to act. L. V. W. C.

761. Recent Developments in Eastern Oil and Gas Fields. P. D. Torrey. *Petr. Eng. Midyear*, 1933, **4** (9), 53.—Proration has enabled operating technology to be studied in the Bradford and Allegany fields.

Suitable water for flooding purposes has received considerable attention, and water filtration and treatment plants have been installed.

Lifting costs have been materially reduced by producing by back pressure and flowing. The delayed system of drilling has been more generally employed and the past year has conclusively proved that this method of drilling will considerably increase the efficiency of water-flooding operations. L. V. W. C.

762. Water Supply and Water Treating in Big Lake Field. K. S. Ritchie. *Petr. Eng.*, May, 1933, **4** (8), 46.—A brief description is given of the pumping operations necessary to provide an adequate supply of water for drilling and camp purposes in the Big Lake oilfield, Reagan County, Texas. Analyses of the well water are given and the effects of treating the water by the zeolite and the lime-soda systems are compared.

The south side well water has a hardness of 60 grains per U.S. gallon, and is treated with zeolite for household purposes and weak lime-soda for boiler purposes. The north side water is superior to the south side water in hardness and total solids, but contains finely-suspended matter which cannot be removed by zeolite as it clogs up the filter bed and also, when carried on to the boilers, forms deposits. Zeolite treatment reduced the total hardness from 35·42 grains per gallon to 2·06 grains/gal., but had no effect on the alkalinity (12·0 grains/gal.). Boiling the zeolite-treated water before it entered the boilers was unsuccessful in preventing the troubles due to suspended matter and dissolved gases. Treatment with hot lime-soda ash reduced the total solids from 79·17 to 62·17 and the total hardness from 35·42 to 3·27 grns./gal. The alkalinity was also reduced from 12 to 4 grns./gal., and there was only a trace of calcium precipitant as suspended matter, the finely divided iron suspended matter and dissolved gases having been completely removed. Also the alkalinity and the sulphate ratio are more definitely controlled so

that the possibility for caustic embrittlement is reduced to a minimum. A comparison of the treating costs shows that the lime-soda method cost 0·44 cents/brl. of water treated, compared with 0·71 cents for the zeolite treatment. The lime-soda softening equipment also had a greater capacity and used only 1/9th as much washing water as the zeolite treater.

Experience has shown that it is economical and a necessity to use treated water in a closed system for the cooling water used in stationary engines and compressors, owing to the dust and sand present in the air and to the large evaporation losses. Elimination of the scale deposit has made substantial savings in operation and repair costs of engines, tubular coolers and condensers. Treated water would also increase the cooling efficiency of the pipe coils in the cooling towers in a carefully-designed installation. C. L. G.

763. Patents on Drilling Apparatus.—G. L. Kothny. U.S.P. 1,912,485, 6.6.33. Recording well surveying apparatus.

E. P. Halliburton. U.S.P. 1,912,578, 6.6.33. Method for cementing combination strings in a well hole.

W. E. Gilbert. U.S.P. 1,912,768, 6.6.33. Gyroscopic well surveying apparatus.

L. C. Tilbury. U.S.P. 1,912,804, 1,912,805, 6.6.33. Liner and wall packers.

C. F. Osgood. U.S.P. 1,912,854, 6.6.33. Drilling mechanism for diamond drills.

G. Raymond. U.S.P. 1,913,041, 6.6.33. Apparatus for controlling flow of fluid from oil wells.

D. R. Knowlton and W. J. Crites. U.S.P. 1,913,489, 13.6.33. Combination hydraulic tubing lift and tubing head.

L. E. Hodges. U.S.P. 1,913,548, 13.6.33. Casing plugging apparatus.

C. K. Holt and J. B. Merritt. U.S.P. 1,913,550, 13.6.33. Multi-cutter drilling bit.

W. E. King. U.S.P. 1,913,636, 13.6.33. Uniform pressure casing cutter.

H. N. Marsh and J. H. Howard. U.S.P. 1,913,845, 13.6.33. Determination of deep well temperatures by lowering solids having graduated and predetermined melting points.

E. L. Rath. U.S.P. 1,914,042, 13.6.33. Double socket eccentric rock bit.

B. S. Gordon. U.S.P. 1,914,251, 13.6.33. A sealing device for sealing the space between well casing and the walls of the hole.

T. W. Bell. U.S.P. 1,914,320, 13.6.33. Non-swivelling jar.

L. V. W. C.

764. Patents on Crude Oil.—M. de Groote. U.S.P. 1,913,538, 13.6.33. Resolution of crude oil-water emulsions by the use of demulsifying agent containing a sulphoabietane acid body selected from the class comprising acids, salts and esters.

R. Reagin. U.S.P. 1,913,955, 13.6.33. A method for blending chemicals with crude oil and basic sediment oil for the separation of impurities. The chemicals are introduced at certain stages with appropriate heating.

W. Haseman. U.S.P. 1,914,665, 20.6.33. Separation of oil and water from emulsions by admixture with an excess of salt water, followed by filtration through a bed of granular material. W. H. T.

Class 400. Transportation, Storage and Distribution.

765. Developments in the Pipe Line Industry. W. L. Baker. *Petr. Eng. Midyear*, 1933, **4** (9), 24.—Pipe line operating practices have suffered from the difficulties which have beset the petroleum industry.

Operating costs are the chief consideration and initial costs are no longer regarded as the most important factor in the construction of new pipe line systems or even in improving old ones.

Recent innovations include the extensive use of meters on crude oil lines, the application of Diesel engines direct connected to electric generators for generating power to drive oil pumps and a new type of pumping unit. The use of cement coatings and interior cement linings and a metalising process for pipe protection are the new developments in corrosion prevention.

Automatic station operation has been advanced with new and improved control instruments offering closer control.

High tensile strength pipe, together with correct corrosion preventative measures, is helping to prolong the life of lines, and the use of modern equipment for pump stations permits efficiency in operating service with the greatest economy. L. V. W. C.

766. New Methods Speed Construction Work on Phillips Pipe Line. Anon. *Oil Weekly*, 10.6.33, **70** (1), 20.—The joints used on the Phillips crude-oil pipe line from Oklahoma City to Thrall are welded butt joints without chill bands.

An angle of 40° was made at the ends of the pipe and 1/32 in. shoulder was left on the lower end. A space of 1/8 in. was allowed between each piece of pipe. For lining up a clamp was used.

So good were the joints that air testing for leaks was discontinued and oil at 1200 lb. pressure was used. L. V. W. C.

767. Corrosion of Petroleum Pipe Lines and Its Prevention. V. Negreev. *Azer. Neft. Khoz.*, 1933, (1), 48–54. (Chem. Abstr., 1933, 27, 2923.)—Among a great variety of compositions protecting against corrosion best results were obtained with a mixture of 50% clay and 50% of an asphalt, m. pt. 80°. This mixture was applied to 8 in. lines connecting Baku with Batum. Pipes of smaller diameter should be coated with a mixture having a higher content of clay. Many experiments are reported and 54 references given. W. W.

768. Pipe Line Corrosion. S. Gill. *Petr. Eng. Midyear*, 1933, **4** (9), 16.—The selection, use and application of pipe-line coating materials that will insure an adequate return upon coating investment have been made possible by the investigations carried out during recent years.

Data upon soil corrosion and coating performance are available but only an intelligent application of the principles outlined will make the coating investment a profitable one. L. V. W. C.

769. Developments in the Use of Electrical Apparatus for Pipe Line Pumping. J. R. Prout. *Petr. Eng. Midyear*, 1933, **4** (9), 40.—Centrifugal pumps have been developed to give their highest efficiencies at speeds up to 3500 r.p.m., and this fact makes the electric motor a desirable device for driving such pumps, since the motor can be directly coupled to the pump.

Where central station power is not available, economically, the centrifugal pump has been coupled to an oil or gas engine. Since the pump is a high-speed device, and the oil or gas engine is a relatively slow-speed machine, some form of speed-increasing equipment is necessary between engine and pump. This equipment can be electrically operated.

Numerous advantages can be gained by using engine-driven electric generators and motors instead of some form of mechanical speed increaser.

Reciprocating pumps driven by electric motors have also been used extensively.

Safety has become important since the advent of the gasoline pipe lines and electric motors, and control equipment for pipe-line work have undergone improvements. L. V. W. C.

770. Automatic Control Stops Flow When Pipe Line Breaks. F. Swindell. *Oil Weekly*, 26.6.33, **70** (2), 24.—A device, which will automatically close the line in the event of a break, is now available.

The control may be installed on any type of gate valve on drilling wells or at refineries.

A description of the control, together with drawings, is given in the article. L. V. W. C.

Class 500. Properties and their Determination.

771. Apparatus and Methods for Precise Fractional Distillation Analysis. IV. W. J. Podbielniak. *Ind. Eng. Chem., Anal.*, 1933, **5** 172–178.—The author describes his apparatus for low-temperature fractional distillation analysis of gases and volatile liquids, which has been standardised by means of automatic recording and control mechanism. The assembly of the apparatus is built up in the following manner:—

Two standard precision low-temperature metal reflector-type fractionating columns, with a 5 ml. distilling flask for one and 1000 ml. flask for the other, are mounted in such a way that either may be used by the turn of a stopcock. The small capacity assembly is intended for gas analysis and provision is made for drying the gas before entry into the flask. Connections to the graduated fraction-collecting burets are made as narrow of bore as possible to prevent lag in distillate measurements. Cooling of the reflux is effected by intermittent compressed air blowing through a thermos flask containing liquid air. A distillation pressure manometer, also manometers for fraction burets and distillate receivers (large bottles kept at constant temperature in a bath), are fitted with the requisite lines, together with a vacuum pump. The distilling flasks are made so that an electric heater will interchange to fit and operate for either one or the other. The whole apparatus is rendered automatic by additional connections being made to the automatic recorder and control apparatus. By means of a fine wire inserted in the open arm of the distillation pressure manometer, electrical contact is made possible to operate, through a relay, a solenoid valve which controls the admission of liquid air to reflux. Automatic regulation of heat supply to still is effected by a differential manometer which actuates a relay. A relay from the distillation pressure manometer operates an electromagnet valve in series with the distillate flow line from the fractionating column controls the column pressure within adjustable limits. The recording and plotting of boiling point and quantity of distillate is made possible by suitable modification of a Brown potentiometer recorder. Automatic signals are incorporated in the apparatus to give additional guidance to absolute control. A table of analysis of a gas mixture is given to show that with the apparatus working under automatic control, results are more positive. Good duplication is quite possible and component parts of the automatic apparatus are reasonably trouble-free. R. E. D.

772. Estimation of Fatty Alcohols in Their Sulphonated Products. K. Lindner, A. Russe and A. Beyer. *Fettchemische Umschau*, 1933, **40**, 93–96; *Oil & Colour Trade J.*, 1933, **83**, 1670–1671.—To estimate the fatty alcohols, the Wizoeff method is used. After splitting with hydrochloric acid, the fatty acids are separated from the petroleum ether solution, the latter being the best solvent for the alcohols. Care must be taken in removing the ether to avoid loss of alcohols.

Pure fatty alcohol sulphuric esters are decomposed with aqueous hydrochloric acid and extracted with petroleum spirit. The latter solution, after washing, is dried over anhydrous soldium sulphate and evaporated.

True sulphonic acids are not readily decomposed by dilute acid and usually remain in the aqueous layer or as a separate layer between the acid and ether. A part, however, may be soluble in the ether and this is separated from the solution by refluxing with slightly alkaline 70% alcohol. The aqueous and alcoholic solutions are combined, neutralised and evaporated. The residue is taken up in 96% alcohol, the inorganic salts filtered off, and the alcohol evaporated. A further extraction with absolute alcohol is usually made to ensure freedom from inorganic salts. Part of the extract is ashed and a correction made. C. C.

773. Analysis of Sulphated Oils. D. Burton and G. F. Robertshaw. *J. Int. Soc. Leather Trades Chemists*, 1933, **17**, 3–16; *Oil & Colour Trades J.*, 1933, **83**, 1672–1673.—A description is given of the Wizoeff method for determining "split" oil. Essentially, it consists in hydrolysing with dilute hydrochloric acid and extracting with ether. The latter solution is evaporated, then saponified and the unsaponifiable matter extracted with ether. Fatty acids are liberated by acid and extracted. Various inaccuracies in the method are indicated.

A chart shows the scheme (due to Schindler) for splitting these oils into six fractions. A modification of the scheme might be necessary if the sulphated oil contained mineral oil. C. C.

774. Viscosity Dilution Function of Lubricating Oils. J. Tausz and A. Rabb. *Petr. Z.*, 14.6.33, **29** (24), 1–3.—Numerous equations involving viscosity dilution are discussed and the following general formulæ cited:—

$$\eta_C = \eta_0 \cdot e^{a_C \cdot f(C)}$$
$$\eta_T = \eta_0 \cdot e^{a_T \cdot f(T)}$$
$$\eta_P = \eta_0 \cdot e^{a_P \cdot f(P)}$$

η_0 represents the initial viscosity, η_C the viscosity at concentration C, η_T the viscosity at absolute temperature, η_P the viscosity at pressure P and a_C, a_T and a_P are constants involving the molecular weight and cohesive and adhesive power of the lubricant.

The authors applied their formula $\eta^{\text{diluted}}_{\text{d}} = \eta^{x}_{\text{undiluted}}$ where η is expressed in centipoises to fatty oils, oils rich in hydrogen, *i.e.*, chiefly paraffinic and naphthenic hydrocarbons, and to oils poor in hydrogen, *i.e.*, chiefly aromatic hydrocarbons. Various tables are given showing results for a series of oils, using 10% and 20% of toluol as a diluent. These are compared with Lederer's formula

$$\frac{\eta_{\text{diluted}}}{\eta_L} = \left(\frac{\eta_{\text{undiluted}}}{\eta_L}\right)^n$$

where η_L is the viscosity of the solvent.

In comparing the values for x and n it is observed that the viscosity dilution factor at 10% dilution of toluol must be multiplied by x to give n, this being 1·03 for oils of high viscosity, and 1·1 for oils of low viscosity. The difference between x and n is quite diminutive for highly viscous oils.

The application of a solvent of a viscosity of about 1·0 gives a value for x which is identical with n, *e.g.*, Mobiloil. Using cyclohexane (n = 0·97) as a diluent the values of x and n are identical within experimental limits.

W. S. E. C.

775. Kinematic Viscosities and Times of Outflow from Commercial Viscometers. F. H. Garner and C. I. Kelly. *Physics*, 1933, **4**, 97–112.—The expression of viscosity in terms of the units particular to the various types of viscometers (Redwood, Saybolt and Engler) introduces difficulties which would be eliminated by the international acceptance of the c.g.s. units; particularly the "stoke," as the unit of kinematic viscosity, since it does not involve a knowledge of the density. The international use of the "stoke" and "centistoke" would be facilitated by authoritative tables or formulae for the conversion of readings from commercial viscometers into kinematic viscosity units.

Attention is drawn to the advantages and difficulties attendant on the use of the "stoke"; methods are also indicated which may be used to calculate the times of outflow at certain temperatures, from one instrument, given two or more readings at other temperatures with a different viscometer —a vitally necessary process, since the temperatures normally used with each instrument are not the same. An examination of available data appears to reveal discrepancies between experimental kinematic viscosities determined with different types of absolute viscometers (capillary type), a feature which constitutes an obstacle to the international adoption of the kinematic viscosity unit.

The main part of the paper consists of an analysis of the present positions held by the Redwood, Saybolt and Engler viscometers.

The Redwood No. 1 Viscometer.—The alterations made in the dimensional specifications of the Redwood viscometers have enforced the redetermination of equations for the conversion of Redwood seconds to kinematic units. "The Higgins Diagram" method was applied to experimental data for the calculation of the instrumental constants in the general equation $V = AT - B/T$ where V = stokes, T = Redwood sec., A and B = constants. Contrary to expectations, one set of values for A and B was insufficient for the whole working range of the Redwood No. 1 viscometer. An inflexion occurred in the Higgins Diagram, starting at T = 100 sec. (approx.), the value of B gradually decreasing to zero as T increased to approximately 400 sec. A method of approximation was therefore applied, in order to derive an equation of the general form to cover the range of efflux times above 100 sec. The two equations obtained for a calculated Redwood No. 1 viscometer are :—

$$V \text{ (stokes)} = 0{\cdot}0026 \times T_1 - 1{\cdot}79/T_1 \text{ for values of } T_1 \text{ below 100 sec.}$$
$$V = 0{\cdot}00247 \times T_1 - 0{\cdot}5/T_1 \text{ for values of } T_1 \text{ above 100 sec.}$$

Redwood No. 2 Viscometer.—A similar inflexion was observed in the Higgins Diagram for a Redwood No. 2 viscometer at values of T_2 about 90–100 sec. The following equation is advanced :—

$$V = 0{\cdot}0247 \times T_2 \text{ for values of } T_2 \text{ above 100 sec.}$$

The suggestion is made that this viscometer may be used for viscosity determination on oils having Redwood No. 1 viscosities over 1000 sec.

Other Viscometers.—As a result of graphical work based on data published by authoritative bodies, the following equations were derived:—

Saybolt Universal Viscometer.

$V = 0{\cdot}00226 \times T_U - 1{\cdot}95/T_U$ where T_U = Saybolt universal sec. 32 to 145.
$V = 0{\cdot}00220 \times T_U - 0{\cdot}8/T_U$ where T_U = Saybolt universal sec. above 145.

Saybolt Furol Viscometer.

$V = 0{\cdot}0224 \times T_F - 1{\cdot}84/T_F$ where T_F = Saybolt Furol sec. 25 to 40.
$V = 0{\cdot}0216 \times T_F - 0{\cdot}6/T_F$ where T_F = Saybolt Furol sec. above 40.

The data used for the above examination were published by the A.P.I. Committee on Viscosity Standards, 1922–24 and 1931 reports.

Engler Viscometer.—The data published by Erk and derived from Vogel's equation were similarly examined, and the following equations are suggested for use in place of the more complex cubic equation by Vogel:—

$V = 0{\cdot}08 \times E° - 0{\cdot}0864/E°$ where $E°$ are between 1·35 and 3·2.
$V = 0{\cdot}076 \times E° - 0{\cdot}04/E°$ where $E°$ are above 3·2.

Attention is drawn to the fact that these equations do not facilitate very accurate conversions of the different viscometer units because: (1) There is a possibility that the kinematic viscosities determined with the various capillary viscometers (B.S.I.) U-Tube, Bingham, Vogel-Ossag, vary with the apparatus. (2) Some countries adopt inadequate procedures for the calibration of viscometers by comparative flow-tests against a standard model (if any). (3) The variation, with the normal temperature of test, of the instrumental constants is unknown.

All these aspects are discussed in the paper. C. I. K.

776. Syntheses of Thiophanes. R. W. Bost and M. W. Conn. *Oil & Gas J.*, 8.6.33, **32** (3), 17.—The results obtained in an investigation of the preparation and properties of thiophanes, listed as project 41 of the A.P.I., are outlined, with particular reference to the most satisfactory method of synthesising trimethylene, tetramethylene, pentamethylene and alpha-methyl-pentamethylene sulphides.

The thiophanes were first isolated from Canadian petroleum by Mabery and Quayle in 1906, a cyclic structure and general formula of $C_nH_{2n}S$ being attributed to them. In 1925 Thierry isolated and identified tetramethylene and pentamethylene sulphide from Persian petroleum. The general reactions of the thiophanes are described with particular reference to the effects of refining agents on pentamethylene sulphide. C. L. G.

777. Trimethylpentanes. K. C. Laughlin and F. C. Whitmore. *J. A.C.S.*, 1933, **55**, 2607–2608.—The authors have prepared 2.2.3- and 2.3.3.-trimethyl pentane and thus are able to tabulate the properties of all the possible trimethyl pentanes. In a previous paper they have stated that on hydrogenation, the dehydrogenation product of methylethyl-tert-butyl carbinol gives some rearranged product besides 2.2.3-trimethyl pentane. P. L. Cramer has stated that a single octane is apparently obtained. The discrepancy is explained by the authors on the grounds that owing to similarity in properties of the two isomers, separation in small amounts would not be possible. E. B. E.

778. Mechanism of Heterogenous Catalytic Organic Reactions. I. Catalytic Hydrogenation. O. Schmidt. *Chem. Review*, 1933, **12** (3), 363–413.—The mechanism of catalytic hydrogenation of multiple carbon bonds is described. The active elements are divided into two classes. The first class includes mono and bivalent elements, *e.g.*, alkalies and alkaline earths which form stable solid hydrides. These elements are at the maxima of the long periods of the atomic volume curve and have a large atomic volume. Their catalytic activity is small, the activity increasing with the diameter of the atom of alkali metals.

The second class consists of bivalent elements or those which have a minimum valency of 2. (iron) or a maximum valency of 2. (copper) which

do not form solid hydrides, but solutions with hyrdogen which have a small atomic volume and are " gap elements " in the periodic system. They are at the minima of the long periods of the atomic volume curve and are the more active the smaller their atomic or ionic radius. Iron, platinum, copper, chromium, manganese and rhenium belong to this group. These metals, when charged with hydrogen, contain positive ions.

In catalytic hydrogenation the ions of the catalyst are the real catalysts, *i.e.*, electrons in class 1 and ions of the metal in class 2. In class 1, the work function is small, the field of the metallic ions is weak and electrons are easily formed at the surface of the metal. The molecular hydrogen is dissociated by free electrons because the affinity of the atomic hydrogen for electrons favours dissociation.

In class 2 the work function is large and the field of the metallic ions is strong. The hydrogen is ionised to form positively charged ions, the energy of which is greater than that of atomic hydrogen.

The process of hydrogenation takes place at active parts of the catalyst, so-called " loose places " of the metal crystal or of metallic hydrides in which ions are loosely bound. The mechanism of hydrogenation of multiple carbon bonds differs from that of the C=O bond, whose affinity of the catalyst for oxygen decides the course of the hydrogenation. W. S. E. C.

779. Purification of Hydrocarbons by Crystallisation from Liquid Methane. Isolation of 2-Methylheptane from Petroleum. R. T. Leslie. *Bur. Stand. J. Res.*, 1933, **10**, 609–618.—Difficulty in crystallising hydrocarbon mixtures of low freezing points may be due in part to the high viscosity of the liquid and a method has been developed in which the liquid mixture is first diluted with propane, ethane, ethylene or other such low-boiling hydrocarbons. This solution is then added drop by drop to liquified CH_4, and if any crystallisation occurs the solid phase is separated from the liquid by means of a centrifuge which permits of the recovery of the volatile solvent.

An apparatus for working with quantities up to about 100 cc. is described in detail.

A petroleum cut boiling between 115° C. and 120° C. was prepared after many careful fractionations and was found to contain a portion distilling near 116° C. which, when examined by the method outlined above, gave a precipitate with a lower refractive index than any likely constituent with this boiling range other than 2-methylheptane. A small portion of this material was further purified until the freezing point and refractive index ceased to change. An examination of its properties was carried out and compared with the data on a sample of the synthetic hydrocarbon reported in the literature. Its infra red absorption spectrum was determined and its freezing point—previously undetermined—found to be −111·3° C. The crude oil was found to contain about 0·15% of this hydrocarbon. D. L. S.

780. Isolation of Ethylbenzene from an Oklahoma Petroleum. J. D. White and F. W. Rose, Jr. *Bur. Stand. J. Res.*, 1933, **10**, 639–645.—A quantity of petroleum distilling between 130° and 145° C. was extracted with liquid SO_2 and on fractional crystallisation of the extract fractions accumulated, which, from their refractive indices and freezing points, obviously contained aromatic hydrocarbons in addition to the xylenes.

By repeated extractions and distillations a fraction was obtained which was found to be impure ethylbenzene. This was further purified by selective sulphonation and hydrolysis, giving a product of 95 mole per cent. purity, the chief impurity being *p*-xylene.

The density, refractive index, boiling point and behaviour on freezing of this sample have been determined and compared with the same properties

of a pure sample of the synthetic hydrocarbon. A photograph of the infra red absorption spectrum of the ethyl benzene from petroleum has also been obtained. It was found that the crude contained about 0·03% of this hydrocarbon.

The freezing points and composition of eutectic mixtures of ethylbenzene with *m* and *p*-xylenes have been determined. D. L. S.

781. Steiner Viscometer. Anon. *Petr. World*, 1933, **30**, 159.—The essential difference between existing types of viscometer and the Steiner type is that in the former the liquid under test has to flow, whereas in the latter the viscosity is determined by timing the rise or fall of a body through a column of the liquid. Advantages claimed for the Steiner viscometer are that smaller samples suffice and the apparatus is handier. The variation of the viscosity of oils with temperature is of great importance, and this determination involves much time with ordinary apparatus. The use of the Steiner viscometer enables such tests to be carried out very quickly and accurately. The viscometer consists of an accurately drawn and calibrated glass tube surrounded by a bath contained in a jacket tube. This bath is either heated or cooled to attain the desired temperature. The inner tube is filled up as far as the air bubble with the oil under test and closed by a stopper. The instrument is then inverted and the time taken for the air bubble to rise a certain distance up the tube. The kinematic viscosity can be calculated from the time taken in rising. It was ascertained by numerous experiments that within certain limits the length of the bubble has no effect on the rising time. As the resistance and also the upward force are proportional to the size of the bubble the rising time remains constant.

G. R. N.

782. Testing Motor Fuels. R. Heilinggotter. *Oil Colour Trades J.*, 1933, **83**, 1606; *Allg. Oel u. Fett Ztg.*, 1932, 397.—The author reviews the problem of evaluating motor fuels by chemical tests, referring especially to the "evaluation index," which is proportional to the paraffin content and the Ostwald distillation index.

Methods for determining aromatic content are also discussed, including the aniline extraction method (Smetana). A table is given relating aromatic content to the volume of residue left after extraction with a definite proportion of aniline at 20° C. The method is said to give inaccurate results with over 32% aromatics. E. B. E.

783. Estimation of Residue-Formation in Motor-Oils. Philippovich. *Erdöl u. Teer*, 1933, **9**, 236–237, 253–254, 267–268.—The author discusses the relation of the tests of lubricating oils to their behaviour in practice, and concludes that the most important properties are the viscosity and the tendency to form coke in the cylinder and sludge in the crankcase. The mechanism of the formation of these residues is discussed. The sludge in the crankcase (or the solid portion of it) has about the same ultimate composition as the coke in the cylinder, viz., approximately 75% carbon, 4% hydrogen and 21% oxygen.

A résumé is given of previous work on carbon formation, and a description of such methods as the Conradson and Ramsbottom coke tests and the oxidation methods of Butkow, Baader, the English Air Ministry and others.

The Conradson and Ramsbottom methods involve carbonisation in a limited supply of air. A description is given of a method developed at the Versuchanstalt für Luftfahrt (DVL). In this, air at the rate of 1 litre per minute is led into a steel crucible supported in a copper heating-block, and

the oil introduced at a speed of three drops a minute. The carbonisation can be carried out at varying temperatures.

In the experimental comparison of various methods, six oils of approximately the same viscosity were used. (The tests are given in tabular form.) These oils were evaluated from their engine performance and placed in order of formation of coke and sludge, from 1 to 6, 6 being the worst. The oils were also evaluated using the Conradson, Ramsbottom, Butkow, Baader and Air Ministry tests, and the increasing order of residue formation determined.

The Conradson test agreed with the engine tests except that oil 3 was worse than 4. The Ramsbottom method also showed 3 worse than 4, and 5 very slightly worse than 6. The carbonisation in air test gave similar results to the Conradson, but 1 and 2, and 4 and 5, were reversed. The results of the Butkow oxidation test were not in agreement with the engine results. Tests by the Baader method were only carried out on oils 4, 3 and 5, the results being in that order and in agreement with the Conradson results.

The Air Ministry tests are in approximate agreement with the engine results except for oil 1, which contains some fatty oil, which shows up worse on test than in practice, and are thought to give valuable supplementary information.

Further work is needed to develop a simple test to correlate with the behaviour of oils in the engine. E. B. E.

784. Incorporation of a Volatility Index in Motor Fuel Specifications. Anon. *Nat. Petr. News*, 24.5.33, **25** (21), 17.—As the result of data made available by recent investigations it appears that the volatility of a gasoline is at least as important as the octane number. Certain figures indicate that a change in volatility index of 10 units has approximately the same influence on performance as a change of 10 units in the octane number. The volatility index is defined tentatively as the numerical difference between the 50% evaporated point on the A.S.T.M. distillation curve and 280° F., the maximum temperature for 50% evaporation according to the Federal specification for non-premium gasolines. H. G.

785. Viscosity-Temperature Zone-Gravity Classification of Lubricating Oils. C. M. Larson and W. C. Schwaderer. *Nat. Petr. News*, 10.5.33, **25** (19), 26–28.—The Dean and Davis and Larson and Schwaderer systems for the determination of the viscosity index of a lubricating oil are discussed. It is pointed out that while evaluations made by the Dean and Davis system are not constant throughout the temperature range of the A.S.T.M. viscosity-temperature chart, evaluations made on the authors' system are constant. A conversion chart is given for the two systems, and the new viscosity-index chart is reproduced.

The viscosity-gravity is calculated as follows :—

$$A = \frac{10\,G - 1{\cdot}0752 \log^{10}(V-38)}{10 - \log^{10}(V-38)} 10$$

where A = viscosity-gravity constant; G = specific gravity at 60° F.; V = viscosity at 100° F. Saybolt seconds. Values calculated from this expression are plotted against the index zone in a graph which is reproduced. The relationship is linear. H. G.

786. Co-operative Research on Motor Fuels between the Petroleum and Automobile Industries. H. L. Horning. *Oil & Gas J.*, 27.4.33, **31** (49), 15.—In a paper read before the N.P.A. the author discussed four major problems

which have been the subject of co-operative research guided by the S.A.E. and the Bureau of Standards.

(1) *Volatility.*—The benefits conferred on the public and on the petroleum and automotive industries by the establishment of those points on the A.S.T.M. distillation curve which control starting ability, dilution and volatility are described and tribute paid to the work of the various organisations concerned.

(2) *C.F.R. Octane Rating.*—An account is given of the difficulties encountered in developing a satisfactory road test method, and of relating the results of these tests with those obtained in the laboratory engine. It is stated that the road test method used in the Uniontown tests enables the operator to distinguish a difference of about one octane number, and that the "motor method" of test in the C.F.R. engine gives a sound method of rating the knock values of all fuels in all types of gasoline engines.

(3) *Anti-knock Rating of Aviation Fuels.*—The confusion resulting from the variety of specifications at present employed for defining the anti-knock valuation of aviation fuels is commented upon. It is considered that the C.F.R. motor method of test used in conjunction with specific recommendations for aromatics and cracked gasolines can be satisfactorily and universally applied for this purpose.

The suggestion is made that to assist the automotive industry and to eliminate wastage of the anti-knock value of gasolines, two octane number standards should be adopted—viz., 62/68 for standard grade and 72/78 for premium grade.

(4) *Essential Specification of Diesel Fuels.*—There is an increasing recognition of the need for more accurate specification of the properties of fuels used in Diesel engines.

The most important property of the fuel is the promptness with which it ignites after injection into the cylinder, as this regulates the starting ability and the roughness of the engine. The smaller the cylinder and combustion chamber, the more exacting is the engine in regard to ignition delay of the fuel used. The more nearly constant the speed and load at which the engine runs, the wider the range of fuels it can use practically. It is predicted that there will soon be a method of measuring the delay period by means of the C.F.R. engine equipped with a Diesel cylinder, employing a special technique, and that new distinctions between gas oils, furnace oils, Diesel fuels, etc., will arise. R. A. E.

787. Standard Rating Needed for Fuels for High-Speed Oil Engines. M. Hofmann. *J.S. A.E.*, 1933, **32**, 204–209.—This paper contains a survey of the work carried out by Ricardo, Le Mesurier, Boerlage and Broeze, and others. A brief explanation is given why it is more difficult to obtain combustion without knock in a high-speed than in a low-speed engine. It is suggested that the time has come for Diesel designers and fuel producers to co-operate to produce a standard rating of oil-engine fuels. The author considers that physical properties do not give an accurate measure of a fuel's delay period in a high-speed engine. The synthetic or cracked group of fuels, which can be distinguished from distilled fuels by their unusually low viscosity combined with high specific gravity and carbon/hydrogen ratio, are unsuitable for high-speed Diesel engines because of their long delay period and consequent "knocking." However, these fuels can be used on a new type of automatic oil engine developed by Hesselman in Sweden. This engine works with a compression only slightly higher than that of a modern carburettor engine, the fuel being injected into the combustion chamber in the conventional way,

but it is ignited by means of an electric spark; thus the problem of the delay period does not exist. Fuels of the aromatic type can be used in this engine.

It is suggested that Diesel fuel specifications should cover the following properties: Standard knock-rating; gravity, expressed as specific gravity, and not degrees A.P.I.; viscosity Say. Univ. at 70° F.; Pour Point; Conradsen Carbon; water and sediment; and sulphur. W. A. W.

788. Tests for Road Tars. F. Bauerfeld. *Asphalt u. Teer*, 1933, **33**, 405–409.—In addition to the usual physical constants, certain molecular forces should be considered. The factors involved include vapour pressure, cohesion, adhesion, surface tension and adsorption. These terms are defined. With tar products, chemical changes proceed on the road surface, so that adhesion, cohesion, etc., may not give an accurate measure of the behaviour on the road. Experimental investigation is difficult.

Considerable importance is attached to the more fluid constituents of tar which penetrate porous stones. Experiment shows that the stone exerts a fractionation action. (This was shown by experiments with benzol solutions of tar.) Various factors may influence the process of hardening. The action of chemical changes is uncertain, but evaporation (*i.e.*, vapour pressure) may play a part. In this respect, tar oils differ from solutions of asphalt in oil, since in the former case the chemical changes have already taken place. Tar layers have no definite structure, the hardening process continuing over a considerable period of time; ultra-violet rays, air, water, etc., all exert an influence. Resinification may occur in air. The future work should include investigation of these questions. C. C.

789. Adhesion of Bitumen and Tar to Solid Road Construction Materials. R. N. J. Saal. *Bitumen*, 1933, **3**, 101–103.—The binding capacity of bitumen or tar with stone and similar road materials can be separated into two components. (1) *Cohesion*—depending on the fluidity and viscous properties of the binder, and (2) *Adhesion*—which depends mainly on the contact surface. This article deals with adhesion and first treats the question from a theoretical point of view. Adhesion-tension is expressed as a function of the surface tension of the binder and the contact-angle.

Separation of bitumen from stone can occur in two ways: either by displacement in the direction of the contact surface of the stone, or by removal perpendicular to the stone surface. In the former case the magnitude of the force is less important, and, if the equilibrium contact-angle is greater than zero, part of the stone may be exposed by drop formation, the thickness of the bitumen layer being the decisive factor. In the second case, much more importance is attached to the initial force required, and, if the difference in the energy required for different materials is relatively small, no conclusions can be drawn from measurements of adhesion-tension and contact-angle. (This is the case with smooth surfaces.)

For the measurement of these characteristics for bitumen and tar with sand, a method similar to that of Bartell (B. F. E. Bartell and C. E. Whitney, *J. Phys. Chem.*, 1932, **36**, 3115) was used. Results are recorded for five different sands and three bitumens (Indian, Mexican and blown Mexican).

It is concluded that adhesion-tension between binder and solid road materials is determined chiefly by the state of the surface of the solid. The author found only a small difference in contact-angle between bitumen and tar, and considers that the adhesion of the binder in practice, under suitable conditions, is quite satisfactory, and no great importance is attached to small differences in the bitumen. C. C.

790. Binder Action of Bitumen. E. Kindscher. *Bitumen*, 1933, **3**, 104–106.—The properties of bitumen-mineral mixtures are influenced by the physico-chemical characteristics of the constituents. They are not merely mechanical mixtures. Much work has been carried out by Wiegand (*Trans. Inst. Rubber Ind.*, 1925, I, 141) and others upon the effect of various fillers on rubber mixtures. A close analogy exists between this and bitumen mixtures. The strengthening action of different fillers depends on the filler, the particle-size and shape, while the binder itself has also an effect. With bitumen, and still more so with tar products (which change under the action of light, air, etc.), the varying nature of the binder complicates matters.

No comprehensive theory, embracing all the phenomena of surface action, has yet been fully developed. Reference is made to the paper by Wilhelmi (*Bitumen*, 1931, I 25) suggesting the connection between attraction and neutralisation of the field of force due to incomplete saturation of the atoms. Energy changes which accompany the phenomenon may be shown in some cases by the development of heat. Different mechanical properties in the product may be obtained according to the extent of the surface-energy change. C. C.

Class 600. Refining and Refineries.

791. Comparison of Steam and Hydrocarbon Gas as Distillation Media in Petroleum Industry. G. Allen and F. T. Gardner. *Oil & Gas J.*, 4.5.33, **31** (50), 12.—A description is given of laboratory experiments carried out in order to make a comparison of steam and natural gas in a series of distillations in order to determine the feasibility of the use of gas distillation.

It is believed that there are no commercial plants utilising natural gas distillation, but in many cases it may prove to be more economical than using low pressure steam, particularly in cold weather when the latter product is in heavy demand. Gas is available under adequate pressure for distillation purposes and after use can be stripped for liquefiable hydrocarbons and finally burnt as fuel.

The following laboratory experiments were carried out :—

(1) 500 ml. of crude oil were distilled to 390° F. and the flashpoint of the residue taken. The oil was heated to 260° F. steam was cut in and the distillation continued with auxiliary heat. From the volume of water distilled, the moles of steam condensed were calculated. An identical distillation was carried out introducing the same number of moles of gas (calculated) through a meter. The flashpoints of the residual tars were taken. It was shown that steam brought over 105 ml. of distillate leaving a residue of flashpoint 210° F. while gas brought over 110 ml. of distillate, the residue having a flash point of 200° F.

(2) The distillations were repeated starting with 750 ml. of crude oil and carrying the preliminary distillation of 480° F., but there was little difference in the results given by the two distillation media.

(3) The comparative effect on the colour of bright stock residue left after removing the distillate from a blend of 40% bright stock and 60% gasoline was determined. The flashpoints of the residue were again comparable, the gas distillation given slightly higher values. The distillation loss was higher in the case of the gas distillation, but the colour of the bright stock residue was slightly better than in the case of steam distillation.

It is concluded that gas distillation would possibly lower the cost of distillation and give bottom products of equal flash and colour to those obtained by steam distillation, but would require the use of suitable separators

to remove mist entrained in the condensate gas, and of equipment to remove liquefiable hydrocarbons from the gas, if best economy is to be obtained.
C. L. G.

792. Cracking Light and Heavy Oils. G. Egloff and E. F. Nelson. *Refiner*, 1933, **12**, 217–221.—Cracking tests were conducted on the following types of charging stocks: 1, Straight-run gasoline and naphtha; 2, Gas Oil; 3, Fuel Oil; 4, Light and Heavy Oil.

1. Pennsylvania, Mid-Continent, mixtures of Mid-Continent and West Texas gasolines and naphthas, and also Joiner (Texas) and East and West Texas gasolines were cracked. In the experimental results, including Octane Number (C. F. R. Research), yielded by the refining of naphtha, the product being blended with the light gasoline fraction, there appears to be no particular advantage, as far as yield and octane number of gasolines obtained, whether the straight-run gasolines or the naphthas are cracked separately or not.

2. A series of cracking runs made on gas oil, derived from Pennsylvania, Mid-Continent, East Texas, Coastal and California crude oils yielded gasolines having octane numbers ranging from 74 to 90, with yields from 61% to 71% of the charging stock. In general, under similar conditions the octane number of the finished gasoline varies with the source of the charging stock, but variation of operating conditions renders possible the production of gasolines of equal Octane Number.

3. Fuel oils from various residues have been processed to produce high octane gasoline and also residues complying with Bunker "C" Specification. Using Smackover topped crude, operating so that the yield of gasoline ranged from 39% to 63% the anti-knock value of the gasoline was maintained constant at 80 Octane Number.

4. Light and Heavy Oil Cracking represents a flexible process in which the naphtha fraction is converted in one heating coil and the fuel oil residue in another, after first topping out a light gasoline fraction of high anti-knock value. East Central Texas Crude Oil yielded 68·5% of 75 Octane Gasoline.
B. C. A.

793. Cracking Art in 1932. G. Egloff and B. L. Levinson. *J. Inst. Petr. Techn.*, 1933, **19**, 504–528.—A review of the literature published in 1932 on the cracking reaction liquid vapour-phase cracking, vapour-phase cracking, cracking with oxidation, by-products of cracking and cracking equipment.
G. R. N.

794. Chemical and Physical Refining. B. C. Allibone. *J. Inst. Petr. Techn.*, 1933, **19**, 539–548.—A review of the literature published during 1932 on the physical and chemical aspects of methods of refining petroleum. G. R. N.

795. Catalytic Hydrogenation of Phenols under High Pressure. S. Ando. *J. Fuel Soc.*, Japan, 1933, **12**, 62–68.—The first part of this paper deals with the catalytic hydrogenation of pure phenol and the intermediate products, cyclohexanone, cyclohexanol, cyclohexene as well as cyclohexane. The reactions were carried out in an electrically heated shaking autoclave, using reduced nickel as the catalyst. The mol. ratio of the reactant to hydrogen was varied from 1 : 1 to 1 : 5 while the reaction temperature was varied from 250° to 470° C. According to the results obtained, together with the nature of the temperature pressure curve it was noted that (1) phenol is converted to cyclohexanol at 160°–260° C. for mol. ratios of 1 : 3 and 1 : 5; (2) between 260° and 350° C. the cyclohexanol is reduced to cyclohexane and water for a mol. ratio of 1 : 5; (3) cyclohexane shows no change until 470° C.; and (4) at 360° C. with a mol. ratio of 1 : 3 phenol is hydrogenated to a

mixture of cyclohexane, benzene and cyclohexanone. The second part of the paper gives the results of the catalytic hydrogenation of the purified 200°/250° C. fraction of phenols extracted by 10% caustic soda from a low temperature tar from a bituminous coal. Hydrogenation at 250° C., using nickel oxide, yielded a mixture of hydroaromatic alcohols of the cyclohexanol series. This mixture was hydrogenated at 335° C. in one experiment and 450° C. in another, using reduced nickel as catalyst. The reaction product in each case was a benzine which was composed chiefly of saturated hydrocarbons chiefly of the naphthene type. Tests on the various products obtained are given. G. R. N.

796. Catalytic Reduction of Tar Phenols to Benzole Hydrocarbons. T. Bahr, and A. J. Petrick. *Brenn.-Chem.* 1933, **14**, 161–165, 187–193.—Phenols in the presence of a suitable molybdenum catalyst are reduced by hydrogen at ordinary pressure to the corresponding benzol hydrocarbon. The most favourable reaction temperature lies between 360° and 380° C. The catalyst prepared by heating ammonium molybdate or molybdenum nitrate, was contained in a copper or iron reaction tube, which tube materials it was ascertained caused no decomposition of the phenols between 300 and 490° C.

Phenol, the three cresols, dioxybenzole, α and β naphthol were investigated, as was also technical phenol mixtures such as tricresol, high boiling phenol and phenol containing tar oils. By the reduction neutral oils containing 80–90% of benzole hydrocarbons were obtained. The formation of high boiling compounds occurs as a side reaction.

Decomposition of the phenols, or splitting off of methyl groups was not observed, neither did hydrogenation occur perceptibly.

Of special interest is the reduction of cresols to toluol, which product was benzole and hydro aromatic free.

Continuing Part I. the preparation and properties of suitable molybdenum catalysts are described. The catalysts are insensitive to sulphur compounds and, after in the course of use losing their activity, can be regenerated by oxidation with air. The reduction in activity is primarily due to a reduction of the catalyst, the active molybdenum trioxide being converted to the inactive dioxide.

The reduction of phenol was also investigated at low pressures of 1–20 atmospheres and at high pressure. By the application of pressure hydrogenation occurs simultaneously with reduction of the phenols, the neutral oil containing from 20 to 40% of saturated and unsaturated hydroaromatics. B. C. A.

797. Formation of Liquid Hydrocarbons from Acetylene. Pt. III. The Production of Benzine by the Electrical and Catalytic Conversion of Coke Oven Gas. K. Peters and L. Neumann. *Brenn.-Chem.*, 1933, **14**, 161–180.—An apparatus is described, wherein using the electrical discharge coke oven gas is converted to gas containing 70% of acetylene, which is further worked up catalytically. In the contact apparatus, which consisted of four brass tubes 50 mm. cross sections connected in parallel, 1·7 litres of polymerisation product was obtained in 64 hours from 32 cubic metres of electrically charged coke oven gas using an iron-nickel catalyst from acetylene, the yield of liquid products amounts to 52·6%. The product consists wholly of unsaturated and aromatic hydrocarbons, 75% boiling under 150° C. A small quantity of hydrocyanic acid contained in the electrically charged coke oven gas is hydrogenated to ammonia. The exit gases freed of liquid reaction products contain 5% ethylene.

An investigation of the temperature effect on the polymerisation reaction indicates, that in spite of a relatively small susceptibility to temperature of

this reaction, the yields diminish, when the dissipation of the heat of reaction from the contact material is diminished by the employment of reaction tubes of larger cross-section. B. C. A.

798. Oxidation Mechanism of Mineral Oils. V. Peroxide Formation in the Oxidation of Refined Mineral Oil. T. Yamada. *J. Soc. Chem. Ind.*, Japan, 1933, **36**, 277B.—In connection with the oxidation of liquid paraffin, the author has used a modification of Wheeler's method for the determination of peroxide. Wheeler's solvent (3 parts of glacial acetic acid and 2 parts of chloroform) was found to give an increasing peroxide value with increasing time of contact with kl. . By replacing the acetic acid with ethyl alcohol, it was found that whereas the liberation of iodine from the kl was slow, a definite end point could be reached after 4–5 hours standing. Experimental evidence shows that oxidation of liquid paraffin is of the nature of peroxidation rather than that of hydroxidation. Oils containing larger proportions of peroxides absorb oxygen faster than those of lower peroxide content. W. H. T.

799. Self-Refrigeration of Lubricating Oils through use of Propane Improves their Quality. R. C. Conine. *Oil & Gas J.*, 4.5.33, **31** (50), 11.—Propane containing some butane is mixed with the oil to be dewaxed in the proportions of 70–75% of propane to 25–30% of oil. Mixing is effected in chillers of 1600 gals. capacity each. The propane-oil mixture is under a pressure of 180–200 lb. per sq. in., so that the propane remains liquid at temperatures of 90–100° F. The chillers are heavily insulated and when mixing is completed the pressure in the chillers is gradually released, with the result that solution temperature may drop to —40° F. The solution remains fluid owing to the high proportion of propane and there is no danger of flow from the chillers being obstructed by wax deposits in the manifold and lines from the chillers to the filtering unit. The filter unit is of vertica lconstruction with a flow rate of about 1 gal. per hr. per sq. ft. of filtering area and the deposited wax is removed from the cloths by reverse flow of warm propane under 200 lb. pressure. The propane-oil solution is forced under pressure through the filter cloths and the filtrate passes out overhead to a working storage tank, from which it is transferred to a propane recovery column where the pressure is reduced to 30–40 lb. per sq. in. Propane is thus removed and is passed to storage. Propane is similarly recovered from the wax slop which drops into the cone-shaped bottom of the vertical filter unit and is removed by means of a worm conveyor. After removal of the propane the dewaxed lubricating stock passes from the bottom of the propane recovery tower through a warm propane heat exchanger and into a storage tank. In the case of the plant described the oil then passes through a chlorex extraction unit of the continuous countercurrent type which represents an improvement in design as compared with the plants previously described (see Abstract No. 563). The final product is stated to have an unexcelled viscosity index. The "self-refrigeration" method of dewaxing is said to be more efficient and cheaper than ordinary indirect refrigeration methods. A schematic diagram of the combined dewaxing and extraction operations is provided. R. A. E.

800. Filtering Wax from Petroleum Oils with Filter Aid. W. P. Gee. *Refiner*, 1933, **12**, 238–244.—By using sufficient filter aid with the precipitated wax in a sufficiently low viscosity solution of the oil, any type of petroleum wax can be removed from any grade of oil. Grades pressed range from low viscosity paraffin distillates to high viscosity residual cylinder stocks; both wide and narrow cuts of distillates and residue have been handled; and waxes ranging from very soft low melting point waxes in partially pressed distillates or neutrals to the more rigid, crystalline waxes. Resultant pour tests of the

oils can be raised or lowered by altering the filtering temperature and the dewaxed oil remains cloud free in almost all cases below the pour point.

Commercial operation has been restricted to the use of petroleum naphtha as diluent, usually of B.P. 150–380° F. The solubility of wax and the relatively high viscosity of naphtha are its chief disadvantages, and other solvents, *e.g.*, acetone-benzole may be used if desired. For the same filtering temperature and other conditions equivalent acetone-benzole compared with naphtha is productive of about 16° F. lower Set Point in the dewaxed oil.

Flow sheets are given with a general description of operation of pressure type and vacuum type filter plants. Slow chilling is not required and is economically unwarrantable. Recovered filter aid is added to the solution chilled to such a temperature as will yield the desired filtering temperature after the effect of the warm filter aid has been manifested. The cold slurry of wax and filter aid is then filtered either by vacuum or pressure filters. The wax-filter aid cake is washed with additional cold solvent when necessary to improve yields, and dried with cold inert gas. The filter aid is recovered by agitation with solvent or weak wax solution, subsequently heated to 150° F. and vacuum filtered continuously. Recovery filter area is approximately one-tenth of cold filter area. The following sequence occurs; a filter aid cake is formed, absorbed water if any is flashed off, the filter aid cake is washed free of wax with fresh hot solvent, the cake is dried with inert gas, and the filter aid cake is charged back to cold mix tank. Filter aids such as "Hyflo Super Cel" and "White Speed Flow" on recovery analyse as follows: Dry Aid, 63%; Naphtha, 36%; Oil and Wax, 0·8%; Water, 0·2%. Thus recovered, the filter aid yields flow rates of 50–60% of that of new aid, and this efficiency is maintained indefinitely with negligible filter aid make up.

A pressure filter plant can be erected exclusive of housing at a cost of $500 per brl. of charging stock per day for a 1000-brl. plant and a vacuum filter plant at $100–$200 less per brl. of stock charged.

Average costs of dewaxing on a vacuum continuous plant run from 1·4 to 2·7 cents per gallon of dewaxed oil including refrigeration and filter aid recovery costs, but excluding stripping costs of dewaxed oil and wax solution and fixed plant costs. Filtering temperatures range from —35° F. to 0° F. depending on the pour test required and pour tests from —10° F. to +35° F. Dewaxed oil yield of about 85–87% without washing on the filter is usually obtained. An average flow rate of about 1·0 gal. of dewaxed oil per sq. ft. of filtering area per hour continuously is obtained on the lower viscosity oils down to about 0·3 gal. on the more viscous stocks. It is anticipated that improved operation will materially increase capacity and give lower pour test.

B. C. A.

801. Dewaxing Oils in Propane Solution with Self-Refrigeration. W. H. Bahlke, R. N. Giles and C. E. Adams. *Refiner*, 1933, **12**, 229–234.—The process comprises the solution of the wax-bearing oil in a liquefied gas such as propane or butane, to produce a homogeneous solution under pressure; self refrigeration by adiabatic evaporation of a part of the low boiling solvent, producing a low temperature and crystallising the wax; separation of the precipitated wax, either by filtration or settling; distillation of the remaining solvent from the two fractions.

Butane solutions of S.A.E. 50 oil at ratios of 65–85% solvent have approximately 0·100–0·150 lower sp. gr., about one-fifth the viscosity and a settling solution tendency of about ten times the rate of equivalent naphtha solutions. Using propane these advantages are enhanced. Comparing naphtha and propane solutions of S.A.E.–50 oil in glass graduates at 75 and 85% solvent concentration, 69% and 81% of clear solution were obtained

in 2 hrs. from the propane solutions contrasting with nil and 2% of clear solution for the naphtha solutions.

Refrigeration rates as fast as 5° F. per minute are productive of filter rates of several gallons per filtering hour per square foot of filtering surface at 50 lb. pressure. Analyses of the wax cake obtained on filtering show it to contain about 30% of oil. From oils containing 12–14% wax, yields of 80% of dewaxed oil were obtained, of pour point –5° F. to –15° F. for filter temperatures ranging between –40° F. and –47° F.

A plant of charging capacity 55,000 gal. daily has been in operation since September, 1932. Propane recovery is by distillation at 200 lb. pressure, using closed steam for heating. From the 200 lb. section, the hot oil solution containing a small amount of propane is throttled to atmospheric pressure and stripped with steam. This steam is condensed in a jet condenser and the propane recovered. B. C. A.

802. Solvent Dewaxing of Oils with Benzole and Acetone. F. X. Govers and G. R. Bryant. *Refiner*, 1933, **12**, 222–228.—The solvent process of dewaxing lubricants using a solvent consisting of a mixture of benzole and acetone has been in successful commercial use at the Lawrenceville, Ill., refinery of the Indian Refining Company since 1927.

Oil from which wax is to be removed is diluted in the proportion of 3 or 4 to 1 with a mixture of 35% acetone and 65% benzole (commercial 90%). Wax is precipitated from the solution by chilling to a temperature slightly below that of the required pour test, about 5° F. in the examples cited. The chilled mixture is forced through a filter to separate the precipitated wax from the oil solution. Both the slack wax mix and pressed distillate are stripped of solvent by distillation.

The plant has a charging capacity of 1200 brls. per day of wax distillate of 75–80 Saybolt Universal viscosity at 210° F., with a 4 to 1 mix and running to –5° F. pour. For a stock of 200–250 viscosity at 100° F., using a 3 to 1 mix, the charging capacity is 1800 brls. of oil per day. Two thousand barrels of solvent suffice to operate the plant. Solvent losses are eliminated by the provision of closed systems where applicable and by oil seals in the solvent recovery system.

Rapid chilling has no practical effect on plant operation, chilling time from 90° F. to filtering temperature taking one to three hours. The breadth of cut within ordinary limits does not affect filtering but influences the pour point of cuts on rerunning.

It is claimed that any distillate within the range of viscosity from 70 Saybolt Universal at 100° F. to 85 Saybolt Universal at 210° F. and a Tagliabue-Robinson colour of one or more, constitutes a practicable stock for this method of solvent dewaxing. B. C. A.

803. Adaption of the Fractionating Still to Absorption Plant Stabilisation. T. B. Leech. *Petr. Eng.*, May, 1933, **4** (8), 22.—The two methods largely used for the extraction of gasoline fractions from cracking still gases—*i.e.* (*a*) circulation through a baffle type or bubble type absorber, and (*b*) absorption in gas oil, have been shown to be insufficiently efficient.

The naphtha method had the following disadvantages: (1) The naphtha had too high a vapour pressure to be an efficient absorbing agent; (2) there was seldom enough naphtha to remove butane and heavier desirable constituents; (3) absorption of lighter constituents (iso-butane, etc.) gave a very high vapour pressure product; (4) in extreme cases the naphtha gas ratio was so low that the naphtha was actually decreased in quantity though the gravity was greatly increased.

The gas oil method had the following disadvantages: (1) High molecular weight rendered absorption slow; (2) frequently there was insufficient gas oil to stop gas effectively; (3) presence of very light fractions decreased condensation of desirable gasoline and increased the load to the absorber, while the continuous recycling of the light hydrocarbons decreased the amount of butanes and heavier absorbed; (4) the presence of the light fractions in the rich absorption oil, if passed to the cracking coils, retards cracking operations.

Suitable equipment has therefore been designed in order to meet the requirements of an inexpensive process which would absorb all pentanes, together with an effective quantity of the butane from the gas and produce the maximum quantity of relative low vapour pressure gasoline.

The equipment consists of a bubble type absorption plant with a fractionating still, side stripper and bottom reboiler. The plant gas passes to the absorber where it is stripped of all pentanes and heavier together with a large percentage of butanes. The enriched absorption oil is pumped through exchangers (hot cycle gas oil from the cracking plant at 560° F.) and into the fractionating still. Stripped absorption oil is taken from the bottom reboiler and gasoline of specified vapour pressure from the side stripper. The residue gas which usually comes from stabiliser accumulators is taken from the still accumulator.

A diagram of the plant and details of the operating conditions are given. The process has the following limitations: (1) It can only be applied to refineries wishing to absorb and retain all the pentane and heavier, but that cannot use all the available butane; (2) a lower water temperature than usual is required in order to obtain effective fractionation without raising the still pressure unduly; (3) oil of lower molecular weight than is generally required should be used; (4) the use of recycle stock as a heat medium results in returning it to the cracking coils in a cooler condition.

In some cases reheating might be necessary. The advantages claimed for the process are: (1) It decreases total water consumption compared with complete absorption and stabilisation plants; (2) Any well built refinery can make its own low molecular weight absorption oil as required. If the oil becomes contaminated, it can be thrown back into the crude cycle and replaced with fresh oil; (3) it eliminates any unnecessary cycling of gas through any other portion of the refinery proper or through the absorber or a re-absorber. C. L. G.

804. Carbon Black Production Lower in 1932. Anon. *Oil & Gas J.*, 27.4.33, **31** (49), 74.—Statistics reported by the Bureau of Mines for the years 1931 and 1932 are tabulated. Total production of carbon black in 1932 amounted to 242,700,000 lb. or 14% less than the 1931 production. Domestic consumption in 1932 was 161,483,000 lb., which is slightly less than in 1931, whereas exports increased to 100,072,000 lb. Although most of the carbon black consumed domestically was utilised as an ingredient of rubber, the quantity so employed shows a decline from 83% in 1931 to 81% in 1932. The amount used for ink and paint manufacture shows an increase in 1932. Production of black is classified according to district and also according to process. Panhandle District, Texas, was responsible for 73% of the 1932 production, indicating a continued centralisation of the industry in this district. Utah and Montana ceased production in 1932. Stocks at the end of the year show an appreciable reduction, but the average wholesale selling price dropped from 3·07 cents per lb. in 1931 to 2·75 cents in 1932. The average yield per 1000 cu. ft. of gas consumed was 1·44 lb. both in 1932 and 1931. Losses increased appreciably in 1932 and amounted to 4,814,000 lb. R. A. E.

805. Carbon Blacks from Acetylene. C. Kaufman. *Chem. Trade J.*, 16.6.33, **92**, 482 (*Canadian Chemistry & Metallurgy*, May, 1933).—The development of the production of acetylene black has been retarded by the high cost of the raw material and by the rapid development of the U.S. natural gas black industry. The special properties possessed by acetylene black has led, however, to its manufacture in Canada and Germany on a commercial scale.

The methods used in its production are: (1) *Channel process*, which gives low yields and is no longer in commercial use; (2) *Explosion process*, in which acetylene under a pressure of at least two atmospheres is decomposed by an electric spark. The resulting black is of an intense dark colour, but less than the channel black, and is in a finely divided and very pure state. At least two firms in Germany and one in France use this process; (3) *Thermic process*, in which acetylene is decomposed by bringing it to its decomposition temperature (800° C.). The carbon is in a very pure form (over 90%), and although the colour is less intensely black than that of the other two processes it is very voluminous and possesses high mechanical absorption, small particle size and high electrical conductivity. Quantities of the black are produced at the Shawinigan Falls plant (Canada); (4) *Electric arc process*, is not of commercial importance.

The properties of the first three types of acetylene blacks vary considerably. Channel process acetylene black corresponds to the American gas blacks, but the thermic process blacks resemble more the high-grade lamp blacks and approach those of finely divided graphite, and accordingly have high electrical conductivites. It has been shown that impingement blacks (*i.e.*, channel blacks) show dense solid bodies and gaseous phase blacks (explosion and thermic blacks) have a loose spongy structure. Oil absorption figures for 1 gram of each of the three types of blacks are as follows: Thermal 5·0 grm. oil, Explosion 3·7 grm., Channel 2·18 grms. This factor is of importance as far as concerns the application in the paint and lacquer and rubber industry, and in employment as filler in liquid oxygen explosives. Channel black readily mixes with water, but the thermic and explosion blacks are not wetted, except in the presence of traces of acids, acetone and pyridine, etc. Analyses of the three types of blacks are given.

	Moisture.	Volatile.	Ether extract.	Ash.
	%	%	%	%
Thermic	0·05	1·3	0·02	0·04
Explosion	0·06	1·0	0·05	0·03
Channel	0·38	3·0	0·6	1·00

The acetylene blacks will not sustain combustion except in the presence of organic or inorganic impurities (dust), when slow glowing combustion results. They have low absorptive capacities and are poor decolorising agents, though they can be improved by activation with air or CO_2.

The chief applications are the same as for other carbon blacks in the printing ink, paint and lacquer and rubber industries, though the high cost of the base product is a great difficulty. A specialised application is in the manufacture of dry cells, the highly graphitic character and extreme porosity of thermic black rendering it a good absorbent for NH_4Cl solution.

Thermic black also finds a special market as filler in liquid oxygen explosives where it competes successfully with cheaper materials—charcoal, cork fillings, etc.,—and as a filler in rubber goods, *e.g.*, racing tyres. C. L. G.

806. Refining. *J. Inst. Petr. Techn.*, 1933, **19**, 497–503.—This covers 1932 reports on refining activities in (1) Germany, by F. Frank; (2) Poland, by

S. Pilat; (3) Rumania, by I. Edeleanu; (4) Canada, by W. W. Goulston; (5) India, by J. A. Carpenter; (6) Trinidad, by A. P. Catherall; and (7) Peru, by J. W. Burford. G. R. N.

807. Cozzbrough Process for Maximum Recovery of Lubricants. Anon. *Refiner*, 1933, **12**, 248.—The Cozzbrough Process is designed to secure from crude residue an increased yield of heavy lubricating oils simultaneously with the continuous production of high-quality asphalts. The process consists essentially of flashing under vacuum of a heated mixture of heavy oil, *e.g.*, crude residuum, asphalt and a volatile component such as gas oil. In the event of insufficient asphalt being present in the crude residuum, additional asphalt is incorporated and also a carrier consisting of a distillate cut having a boiling range from heavy naphtha to light gas oil. The mixture is coil heated and flashed in a vacuum column, whereby the carrier and heavy lubricating oil are vaporised, leaving the asphalt behind. By reason of the variation in volatility of the vapour components, their separation is readily effected. The asphalt used is reduced by the process, yielding a very hard residual asphalt.

Applied as a matter of academic interest to residual cylinder stock from Penna Crude, it is claimed that the process resulted in the practically complete recovery of the stock as distillate. B. C. A.

808. Effect of the Rate of Cooling in the Manufacture of Aluminium Stearate Greases. F. J. Licata. *Nat. Petr. News* 7.6.33 **25** (23), 23–24.—According to the article, the properties of a grease containing 10% wt. of aluminium stearate depend on four factors: (1) Properties of the stearate; (2) properties of the oil vehicle; (3) rate of cooling after solution; (4) extent to which the grease is stirred during cooling. A table shows that a grease cooled in 3 hours is of a very granular texture and has a consistency of over 4500 grms. (determined on an improvised instrument). Where the cooling was protracted over a period of 60 hours, the grease was soft, of long "feather" and a consistency of 100 grms. It is recommended that a 30 gallon batch be cooled rapidly from 275° F. to 160° F., and then be run in 4–5 in. deep layers in shallow pans where, in normal weather conditions, the grease will cool to 70° F. in 24 hours. It is shown that if a grease be stirred continuously until its temperature has fallen to 80° F., it will flow through a 1 in. opening. H. G.

809. Preparation of T.N.T. from the Aromatic Gasoline of Shukoko Crude Oils. M. Mizuta. *J. Soc. Chem. Ind.*, Japan, 1933, **36**, 254B.—Continuing his previous work on the preparation of di-nitro toluene from Shukoko crude, the author has determined the optimum conditions required to convert 2–4-dinitrotoluene into α-trinitrotoluene, the greatest effect on the yield of T.N.T. being by the use of HNO_3 of S.G. 1·52. Using 4 parts H_2SO_4 (S.G. 1·84) and 1 part HNO_3 (S.G. 1·52) for 1 part of the di-nitrocompound, the yield was 98% as crude product or 92% of purified α-trinitrotoluene. W. H. T.

810. Distillation and Fractionation Equipment R. R. Fischer. *J. Inst. Petr. Techn.*, 1933, **19**, 529–538.—A survey of the development during 1932 of distillation and fractionation equipment in the refining of crude petroleum and its products. G. R. N.

811. Modern Pipestill Heater Design: 2. Radiation in Pipestills. W. L. Nelson. *Petr. Eng.*, May, 1933, **4** (8), 30.—In the design of modern pipestills there is a tendency to increase the amount of heat absorbed by the radiant bank section, but this is ultimately limited by the excessive surface required.

The extra cost of a large radiant section is offset by the greater life of the walls and furnace tubes, due to the lower rate of heat input, while certain operations, *e.g.*, the heating of treated lubricating oil stocks and cracking definitely require a low rate of heat absorption.

The distribution of radiation in different parts of the radiant section is discussed. There are usually only two rows of tubes in the radiant section, as the second row of tubes will absorb 43% of the heat absorbed by the first row, and third row only 12%. The first row of tubes in the convection section may also absorb heat by radiation from the flame and from the hot gas. Here, again, the second row of convection tubes will absorb 56% of the heat absorbed by the first row, and the third row 19% of this, while the fourth row only absorbs 4%, and the fifth row 1·5%.

The total rate of heat absorption in the first few tubes of the convection bank both by convection and radiation is calculated, and it is shown that the first row absorbs about 60% more heat than the most severely heated radiant tube. For this reason these first rows of the convection bank are designed for higher oil velocities, while steam superheater tubes are also often placed between the radiant and convection banks for protection.

Data on several stills have shown that radiation rates vary by 400% in different parts of the radiant section. A method is given of calculating approximately these radiant variations. This method has given computed results within 5% of actual results.

As mentioned in the first article (see Abs. 556), the observed coefficients of heat transfer are usually 60% to 250% higher than the pure convection coefficients. This is due to: (1) radiation from the hot flue gas, and (2) radiation from the hot walls of the convection section. Monrad (*Petr. Eng.*, April, 1933, **4** (7), 21) gives a relation for calculating the coefficient of gas radiation, and a further relation for calculating the wall effect is reproduced. From these two, a complete coefficient of heat transfer in the convection section is computed, and a table given of these coefficients. Further tables are given showing: (*a*) that the allowable absorption rates of recently designed stiles are not affected by any preheating or recirculation of flue gas, although the radiation factor is greatly affected; (*b*) the effect of flue gas recirculation on the radiation factor under the following conditions: (1) a constant absorption rate of 17,000 B.Th.U.; (2) a 12° A.P.I. fuel having a G. of 18 lb. air per lb. fuel; (3) 25% excess air; (*c*) the change of absorption rate with different recirculation, but in a simple still in which the radiant surface is not changed. C. L. G.

812. Normandy Plant of French Company Incorporates Modern Trend in Design of New Equipment. Anon. *Oil & Gas J.*, 15.6.33, **32** (4), 12.—A refinery designed primarily for handling Mesopotamia Crude is being constructed near Le Havre, and will process when completed 1,600,000 tons of crude oil per annum. It will be equipped with cracking as well as distillation facilities, wax plant and lubricating oil and asphalt plants.

The crude oil is first settled at 115° C. for 45 mins. under pressure of 14 kg/cm² and the dehydrated crude passed to a pipe-still where it is heated to 140° C. and flashed in a fractionating tower to remove H_2S and the more volatile hydrocarbons. The light fractions are condensed and the dry gas used as fuel while the condensed products are passed to a stabiliser. Pretreatment is expected to yield 93% clean crude oil, 5% stabilised light gasoline, 1% B.S.& W. and 1% gas. Two McKee distillation units of capacity 8000 brls. allow the recovery of gasoline, solvent naphtha, two kerosine cuts, two gas oil cuts, a pressable wax distillate and fuel oil bottoms. A secondary tower permits production of aviation gasoline and heavy naphtha. Two Cross cracking units of capacity 3000 brls. per day will process distillates or

fuel oil and will be equipped with a combined absorption and stabilising apparatus.

The cracked gasoline is acid treated and redistilled on a Foster Wheeler unit which utilises the waste heat of residue from the cracking plants without further heating. The light fractions are flashed off in an atmospheric fractionating column, entering at 140° C., and the residue gas fed to a vacuum column at a similar temperature where a naphtha cut is produced. The P.D. bottoms are stripped by passage through a reboiler before being pumped to storage. The kerosine distillates will be treated by the Edeleanu process, with a possibility of the extension of the plant to treat lubricating oils.

An unusual feature in the refinery is the installation of a central plant destined to store all chemical products, prepare them for refinery use and to deliver them to the various process installations at the proper concentration. Installation for handling refinery waste products will also be available. A flow sheet of the plant and sketches of the steam generators with several more features are reproduced and details given of the tankage, shipping, fire prevention, steam power and other facilities. C. L. G.

813. Treating Refinery Waste Water to Prevent Contamination. Anon. *Refiner*, 1933, **12**, 245.—An installation for the treatment of refinery waste water with lime and sodium aluminate, whereby the venting of waste water is eliminated, is described. Water so reclaimed is used only in the condensing and cooling system of the refinery. B. C. A.

814. Patents on Cracking. Gasoline Prods. Co. E.P. 393788, 15.6.33.—The stock is distilled to yield pitch, coke and vapours. The latter are fractionated to give gasoline, a heavy condensate and a liquid residue. The condensate is cracked and returned to the fractionation zone.

J. Black. U.S.P. 1,912,882, 6.6.33. Liquid-phase cracking with withdrawal of a portion of the cracked stream, its blending with feed stock and the recirculation of the mixture into the stream.

G. Dunham. U.S.P. 1,913,049, 6.6.33. Liquid-phase cracking with the introduction cooled condensate to the vapours of the reaction zone between the separator and fractionator. This cools the vapours passing to the fractionator and reduces their volume, thus allowing an increased amount of reaction zone product to be handled.

S. Swartz. U.S.P. 1,913,619, 13.6.33. Production of cracked gasoline and residual oil free from carbon. The charging stock is mixed with powdered calcium hydroxide which is removed after cracking together with carbon, by settling.

A. Mittasch and M. Pier. U.S.P. 1,913,940 and 1,913,941, 13.6.33. Dehydrogenation of hydrocarbons, containing cyclic non-aromatic compounds, for the production of aromatic hydrocarbons. The reaction is carried out at atm. press. at 300–600° C. in the presence of a catalyst (molybdenum oxide and alumina) and absence of oxygen. In U.S.P. 1,913,941, the catalyst comprises active carbon and an oxide of a metal of the sixth group of the periodic system.

W. Ischie. U.S.P. 1,914,373, 20.6.33. Apparatus for liquid-phase cracking with means for preventing the coking-up of the discharge-end of the transfer line.

E. Gard. U.S.P. 1,914,914, 20.6.33. Vapour-phase cracking with provision for high vapour velocities in the cracking tubes.

D. Stevens. U.S.P. 1,915,206, 20.6.33. Conversion with the aid of aluminium chloride. The mixture of oil and 2–3% of the catalyst is heated at about 400° C. in the absence of hydrogen for 6–15 mins. under a pressure of 1000–3000 lb. per sq. in. W. H. T.

§15. Patents on Hydrogenation. U. K. Oil Co. E.P. 393664, 15.6.33.—A mixture of hydrocarbons and steam is heated in the presence of a catalyst. The latter is an alloy of tin and iron to which is added nickel, chromium or cobalt or a combination of these.

M. Pier. U.S.P. 1,912,856, 6.6.33. Improvements in the separation of liquid constituents from the products of destructive hydrogenation. A flocculating agent (sawdust, aluminium sulphate and manganese resinate) is used to effect the precipitation of solid material, the latter being subsequently removed by filtration.

H. Waterman. U.S.P. 1,915,394, 27.6.33. Liquefaction of solid carbonaceous materials in the presence of high pressure hydrogen, including the following steps: (*a*) heating to a suitable reaction temperature; (*b*) discontinuing heating; (*c*) rapidly reducing temperature whereby only a small quantity of low boiling products are formed; and (*d*) separating the latter while still at high temperature and recovering heavy fluid products substantially free from low boiling constituents.

J. Black. U.S.P. 1,915,592, 27.6.33. Hydrogenation is effected by heating oil to about 800° F. (without cracking), mixing with hydrogen and passing the mixture (at above 500 lb. per sq. in.) through an elongated passage way for a sufficient time to allow hydrogenation to take place while continuously reducing the temperature to about 600° F. W. H. T.

§16. Patents on Motor Spirit. M. Sumpter. U.S.P. 1,912,603, 6.6.33.—Treatment of light hydrocarbons, particularly cracked gasoline with a mixed-base oxychloride [*e.g.*, $Zn\,Cl_2 : Zn\,O\,2H_2O$ or $3\,(Zn\,Cl_2, 3Zn\,O)\cdot 2\,(Pb\,Cl_2, Pb\,O)\,14H_2O$] for the removal of gum and colour forming bodies and sulphur.

A. Seigle. U.S.P. 1,913,061, 6.6.33. A motor fuel consisting of a mixture of 50% unsaturated and 50% saturated hydrocarbons, the fraction distilling between 80° and 90° C. remaining free from nitrobenzene when treated with nitric acid. The mixture consists of 88–89 parts of carbon and 12–11 parts of hydrogen.

A. Lachman. U.S.P. 1,914,668, 20.6.33. A method of removing acid constituents from hydrocarbon vapours by treatment with steam (15 lb. per sq. in. at 300–340° F.) and calcium carbonate.

B. Malishev. U.S.P. 1,914,953, 20.6.33. Treatment of untreated cracked gasoline by distillation in the presence of phosphorus pentoxide and a halide of copper. W. H. T.

§17. Patents on Lubricating Oil. J. Stormonth. E.P. 393,125, 1.6.33.—Reclamation of used lubricating oils by heating, settling and then admixture with castor oil saturated with mineral oil (10% at 160° F.). The mixture is cooled to 70° F., the oil being separated from the reagent and deleterious matter by centrifuging and finally treated with decolorising earth and filtered.

M. Pier and F. Christman. U.S.P. 1,914,727, 20.6.33. Preparation of lubricating oil from coal-tars, mineral oils, etc., by subjection to chemical condensation in the presence of an anhydrous metal halide. The product thus obtained is given a non-destructive reduction treatment with hydrogen at 250°–460° C. and 5–1000 atm. press. in the presence of a catalyst immune to poisoning by sulphur.

G. Maverick and G. Matheson. U.S.P. 1,914,999 20.6.33. Purifying used lubricating oil by passage through an artificially formed mineral fusion product having a fibrous structure adapted to remove solid particles from the oil. The mass contains alkaline material adapted to neutralise from the pounds in the oil. W. H. T.

818. Patents on Asphalt. H. Swerissen. U.S.P. 1,912,667, 6.6.33.—A process for oxidising asphalt by the air-blowing of a continuously recirculating stream of asphaltic oil. Untreated oil is continuously introduced into the circulating stream, oxidised asphalt being removed from a vapour separating zone. W. H. T.

819. Patents on Special Products. W. Reddish. E.P. 392,931, 15.5.33.—A solvent for the removal of both oil and water soluble stains. It consists of a mixture of any of the usual organic solvents with 1–20% of dispersed water, the dispersion being effected by the addition of an equal quantity of mahogany sulphonates (a by-product from the treatment of medicinal white oils). The material to be cleaned is treated with the neat solvent before using the mixture. S. B.

W. Triggs. E.P. 393,102, 1.6.33. A medicinal oil solution containing liquid mineral oil compounded by means of an amine soap with an alkyl amine salt of an acidic organo-mercuric compound normally insoluble in oil.

J. Giron. E.P. 393,600, 6.6.33. Production of rubber-like material from uncracked oil (C.p. 280°–370° C.) by admixture with a liquid fermentation product of cellulosic and sugary vegetable material. The mixture is fermented in the presence of water and subjected to aeration and actinic light until the water has evaporated leaving an oil menstruum. The latter is sulphurised to form a rubbery material capable of further vulcanisation.

Bat. Petr., Mij. E.P. 393,753, 15.6.33. Preparation of mixed ethers from *tert.* olefines and aliphatic polyhydric alcohols, the reaction taking place in the presence of condensation catalysts at below 150° C. W. H. T.

820. Patents on Kerosine. G. Cattaneo. U.S.P. 1,913,658, 13.6.33. Improved method for recovering the liquid SO_2 employed for treating hydrocarbons in a sufficiently pure state for further use. W. H. T.

821. Patents on Gas. C. Wagner. U.S.P. 1,913,691, 13.6.33. Manufacture of gasoline from unsaturated hydrocarbon gases of the ethylene series. The gas is heated to 350°–700° F. at 40–100 atm. press., and then brought into contact with a catalyst (a metal of the 8th group of the periodic system), thereby forming additive hydrocarbon compounds of higher molecular weight.

R. Halloran and A. Kremser. U.S.P. 1,915,781, 27.6.33. A multi-stage absorption process for the extraction of gasoline from natural gas. W. H. T.

822. Patents on Refinery Plant.—G. Bogart. U.S.P. Re. 18,862, 6.6.33. A fractionating tower for volatile hydrocarbons.

L. Huff. U.S.P. 1,912,640, 6.6.33. A method for the removal of solids from the interior of a dephlegmator, expansion chamber or still. Pans are provided for the reception of solid matter, and these may be cleaned by the introduction of steam, benzol or other solvent.

J. Wallis. U.S.P. 1,913,465, 13.6.33. A fractionating plant equipped with means for stripping side-streams by means of steam.

W. Lummus. U.S.P. 1,913,602, 13.6.33. A method of condensing vapours without appreciable fractionation by the use of a minimum amount of absorbing or cooling fluid.

W. Lummus. U.S.P. 1,913,603, 13.6.33. Apparatus for the fractionation of crude oil into a number of different products.

U. Jenkins. U.S.P. 1,913,635, 13.6.33. A cracking still provided with a propeller for the definite circulation of the oil charge in order to augment the circulation due to thermo-syphonic action.

W. Barker. U.S.P. 1,915,397, 27.6.33. A still furnace with means for the recirculation of hot spent gases.

M. Mann and F. Archibald. U.S.P. 1,915,433, 27.6.33. A method for removing spent clay from filters or filter presses and simultaneously recovering oil from the spent clay, by washing out with water.

E. Luster. U.S.P. 1,915,681, 27.6.33. A fractionation tower for use with liquid and vapour phase cracking processes.

G. Miller. U.S.P. 1,916,124, 27.6.33. A furnace for use with a "cracking cylinder." W. H. T.

Class 700. Utilisation.

823. Interim Report of the Research and Standardisation Committee on Cylinder Wear.—Anon. *J. Inst. Aut. E.*, June, 1933, 73–92.—This research programme was carried out using J.A.P. 500 c.c. single-cylinder engines of two types, *viz.*, a dry sump side-valve type and an O.H.V. wet sump engine, two being coupled to electric dynamometers and two to water brakes. Adjustable thermostats and thermocouples enabled accurate control of temperatures to be maintained throughout. Very accurate determinations of wear were made possible by the use of special micrometers and gauges. With regard to cylinder wear generally, it was found that: (1) maximum wear occurred at the top of the ring track; (2) there was usually a second "maximum" at the bottom of the ring track; (3) wear was almost entirely confined to the ring track; and (4) wear was usually fairly uniform round the barrel. Piston ring wear was determined by weight, which enabled measurements of the order of 0·000016 in. in diameter to be determined. Piston skirt wear was generally so small that the readings obtained were of doubtful accuracy owing to relatively short duration of runs. The first experiments were run under conditions popularly supposed to cause wear, but it was found that oil dilution even up to 90% did not produce accelerated wear except when the oil was contaminated with abrasive matter. It was also found that cylinder wear was independent of wall temperature between 125° C. and 265° C., neither did delayed lubrication and strangling occurring in starting accelerate wear if warming up was sufficiently rapid.

When warming up was delayed, however, especially with scanty lubrication, wear became much more rapid, and it was concluded that cylinder wear was mainly caused by low cylinder wall temperature, and showed a rapid rise below 90° C.

The tests apparently show a connection between condensation on cylinder walls and wear, and it is concluded that corrosion is caused by formation of acids during combustion. Some tests were made in which hydrogen was used as a fuel, and wear was much reduced, presumably as a result of the absence of these combustion products. Austenitic iron, which is a corrosion-resisting material, added further evidence in support of the conclusions reached as wear was considerably lessened by its use. C. H. S.

824. Scavenging by Large Valve Overlap Increases Power and Economy. O. W. Schey. *J.S.A.E.*, 1933, **32**, 210–216.—In a conventional four-stroke engine the maximum volume of charge that can be inducted is equal to the volume swept, since the piston on the exhaust stroke cannot scavenge the clearance volume. With complete scavenging the power output should be proportional to that obtained with normal scavenging in the ratio of the volumes of the charges. With a compression ratio of 5 : 1 this ratio would be 1 to 1·25.

To obtain this increase with a conventional engine at sea level would require an increase of carburettor pressure of approximately 7 in. of mercury, and a corresponding increase of supercharger power. This paper deals in

detail with an investigation of the relative performance of an engine with normal and complete scavenging. The tests were carried out by the N.A.C.A. on their single-cylinder universal test engine. A description of the equipment used together with the results obtained are given. These are summarised as follows: (1) The clearance volume of an engine can be scaveneged completely by using a large valve overlap and about 2 to 5 in. of mercury pressure difference across the intake and exhaust valves. (2) Scavenging an engine by the use of a large valve overlap results in a large increase of power and exceptionally good economy at practically no cost in supercharger power. (3) The solid injection of a low volatile fuel gives satisfactory operation, except that the fuel consumption is high. The use of this fuel should practically eliminate crash fires. C. H. S.

825. Successful Valve-Design Considerations. H. L. Horning. *J.S.A.E.*, 1933, **32**, 224–225.—The length of an engine is governed by the size of valve heads and the necessary space between them, if all the valves are to be arranged in line. Due to the increase in speed of the modern engine in relation to normal speeds of a few years ago, it has been found necessary to use inlet and exhaust valves of different head diameters in order firstly to ensure good volumetric efficiency and, in the case of the smaller exhaust valve, to cut down as much as possible the area exposed to flame contact and so the temperature of the valve.

The author states that it is now desirable to design engines with the clear diameter of the exhaust valve as low as 75% that of the inlet valve. Various considerations which affect the ability of the exhaust valve seat and stem to dissipate heat are dealt with. Among things of interest which the author mentions is the statement that it has been found that the difference in temperature of an exhaust valve with a well-lubricated, as against a poorly lubricated, stem may be as much as 250° F. Valve-spring design and various problems involved therewith are dealt with. The author thinks that correct spring design is the factor that more than any other affects the engine as regards long life between overhauls. C. H. S.

826. Sulzer Four-Cycle Engine. Anon. *Oil Engine*, 1933, **1**, 22–23.—This engine uses a system of air admission known as the "Compound Admission System" which increases specific output by increasing the supply of combustion air.

The principle consists of dividing the air supplied into two separate parts. Some of the combustion air is drawn in the usual manner from the atmosphere through valves in the cylinder head, whilst the remainder is fed through a compressor to ports at the bottom of the cylinder and enters after the inlet valves are closed. The compressor absorbs only 40% of the power required in systems where the whole of the air is compressed. The engine has been strengthened to meet the requirements of the increased mean pressure as compared with the older designs.

The engine is specially suitable for marine auxiliary service, as with this system the exhaust piping can, if desired, be cooled, which is a distinct advantage, especially in the tropics. The fuel consumption is very uniform, not rising above 0·38 lb. per B.H.P., between ¾-load and 10% overload. The engine is of airless injection type and apart from the special air admission system the design calls for no special comment. C. H. S.

827. "R.N." High-speed Diesel Engine. Anon. *Oil Engine*, 1933, **1**, 29.—The chief feature of this engine is the combustion chamber design. Combustion takes place in a narrow offset cylindrical chamber with convex walls into which a heat resisting plug, secured to the piston crown, enters

at about 12% from the upper end of the stroke. A violent swirl is given to the air entering this chamber through a tangential entrance. Grooves in the sides of this entrance ensure that, as the plug enters, most of the remaining air in the cylinder is forced into the combustion chamber at increased velocity thus further atomising the incoming fuel, and at the same time carrying away the sides of the cone of fuel into the dense air revolving near the outer edge of the chamber, ensuring good mixing. It is claimed that this design shields the walls of the cylinder from the combustion and protects the piston from the burning oil stream. This rotational movement also occurs during the exhaust stroke and prevents oil from being deposited on the exhaust valve stem. The valves are horizontal, and the heads form the side walls of the combustion chamber. Bosch pumps are employed, and the engine gives 7 B.H.P. per cylinder at 800 r.p.m. The B.M.E.P., at full load, is 99 lb. per sq. in. The fuel consumption has been independently certified at 0·393 lbs. per B.H.P./hour, and the lubricating oil consumption is approximately 1% of the fuel consumption. The sizes range from 7 to 60 B.H.P. C. H. S.

828. Coventry Climax B.4 Engine. Anon. *Auto. Eng.*, 1933, **23**, 213–4.—Details of a 4-cycle engine of medium capacity intended for commercial vehicles.

The engine has a swept volume of 241·7 cu. in. and the R.A.C. rating is 24·03 H.P. The compression ratio is 4·841 and 63 B.H.P. is developed at 2500 r.p.m. corresponding to B.M.E.P. of 83 lb./sq. in. The maximum B.M.E.P. of 102 lbs./sq. in. is, however, developed between 1250 and 1500 r.p.m. The side by side valves are slightly inclined and totally enclosed. The lubrication system is full pressure feed to crankshaft and camshaft, whilst pistons and gudgeons are fed by splash. The general design of the engine appears to follow conventional lines. Photographs and sectional drawings are given, also curves showing bench performance and fuel consumption. C. H. S.

829. Leyland 8-Litre Oil Engine. Anon. *Auto. Eng.*, 1933, **23**, 199–202.—A description of a new engine which follows the general design of the "Tiger" petrol engine. The R.A.C. rating is 46·8 and the output is 55 B.H.P. at 1000 r.p.m. and 87 B.H.P. at the governed speed of 1800 r.p.m. The combustion chamber is unusual, if not unique, as it consists simply of an open cup in the piston head into which the fuel is injected from a single hole nozzle. The entering air is given a swirl by means of a screen on the inlet valve. Although the delay with this arrangement is long the pressure rise is gradual to a maximum of 45 lbs. per degree crank angle and the engine is claimed to be very quiet when idling or under load. It is interesting to note that this type of combustion chamber was successfully employed on the first automotive oil engine built in this country. The pump employed is a C.A.V.-Bosch type P.E.B., which provides an idling speed of approximately 350 r.p.m.
C. H. S.

830. Alcohol Blend Less Efficient as Motor Fuel. Anon. *Oil, Paint and Drug Reporter*, 1933, **123** (26), 37.—The following summarises co-operative tests made by the American Automobile Association, the Bureau of Standards and interested oil companies on alcohol blend fuels. Road tests with a fuel containing 10% of alcohol showed that the blend is nearly 5% less efficient than regular gasoline; while the laboratory tests showed heavier fuel consumption when the blended fuel was used and also that its use required a richer flow for acceleration. Operation of four conventional-type automobiles in road tests over a 10-mile course showed that the alcohol blended fuel is on the average 4·94% less efficient than regular gasoline. Road tests with a

fifth automobile run at the same time over a measured mile showed a decrease in miles per hour, miles per gallon of gasoline and increase in fuel consumed when the alcohol blend fuel was used. Observations in the laboratory tests disclosed fuel consumption with the blend to be 4·5% greater than with regular fuel. Acceleration tests revealed that with a fuel containing 10% of alcohol a carburettor setting giving about 3% greater fuel flow was required to secure acceleration equal to that given by straight gasoline. The 10% alcohol blend improved the anti-knock quality of the fuel, but only to the extent of one-fourth to one-third of that secured from the highest test premium fuels. The alcohol in the blended fuel absorbed moisture from the atmosphere and the mixture of alcohol and water separated from the gasoline.

G. R. N.

831. Alcohol-Blend Fuels. H. L. Horning (Report of C.F.R. Special Alcohol-Blend Committee). *J.S.A.E.*, 1933, **33** (1), 29.—The special C.F.R. committee, reporting on well-authenticated facts in connection with the use of alcohol-gasoline blends, makes the following observations :—

For equal acceleration, the fuel consumption of the blend is 4% higher than with straight gasoline—corresponding to the heat contents. Engine starting is more difficult and the tendency to vapour-lock more pronounced with the blend. The octane number is about 5 units higher than that of the gasoline. Water absorption from the air and storage conditions are frequently sufficient to cause separation.

Ethyl alcohol is not so desirable as the higher alcohols for blending purposes ; alcohols can be produced more cheaply from petroleum than from agricultural products.

Problems of corrosion and solvent action and economic considerations also arise. A detailed report and experimental programme are being prepared.

E. B. E.

832. Mercaptans as Resin Producers in Motor Benzole. O. Kruber and W. Schade. *Brenn.-Chem.*, 1933, **14**, 124–128.—Non-volatile resins are formed by the addition of mercaptans to the unsaturated constituents of motor benzole. The phenomenon of mercaptan addition has long been recognised as also has the pitch forming properties of noxious sulphur compounds and the addition of sulphur and similar substances to olefines, leading to asphalt formation.

On distilling a mixture of cyclopentadiene and ethyl mercaptan, which has stood for fourteen days, an oily fraction B.P. 140–5° C./15 mm. is obtained, which contains 15·98% sulphur, corresponding to 16·48% sulphur for the hypothetical addition product. Depolymerisation of this oil at 210–220° C. regenerates cyclopentadiene and ethyl mercaptans.

Solutions of refined motor benzole with ethyl mercaptan content varying from nil to 0·05% were stored in glass flasks in ordinary light and tested at intervals for resin formation up to a total storage period of twelve weeks. Similar solutions containing 0·5 and 1·0% of cyclopentadiene or dicyclopentadiene, with and without 6 mgm. of ethyl mercaptan per 100 ml. were also tested for resin formation after nil, four and ten days storage. Compared with the uncontaminated benzole all samples in both series showed an increase in resin formation, the effect of the mercaptan and cyclopentadiene being the more marked.

B. C. A.

833. Creosote as a Tractor Fuel. J. Havers. *Motor Transport*, 17.6.33, **56** (1475), 5.—A description is given of the conversion of a haulage tractor for the use of creosote as a fuel. Two Solex carburettors were fitted, a small one for starting and idling on petrol, a second and larger one for creosote.

The feed from the latter is through a long induction pipe formed by the cored casting of the exhaust manifold. The tractor is started on petrol and the radiator blind is drawn until the engine is thoroughly warmed, a process which is facilitated by the presence of a baffle between the fan and the exterior of the induction manifold. A lost motion device shuts the petrol throttle when the creosote throttle is opened, and *vice versâ* when the fuel is changed over from creosote to petrol.

The engine was examined after running 575 miles in 3 months, and it showed no signs of untoward results from the use of the new fuel. The piston heads are stated to have been singularly clean, but the deposit on the inlet valves stems above the guides was heavier than usual. The deposit in the crank case appears to have been heavy. The lubricating oil was a straight mineral oil and was changed after one month, when dilution had occurred to the extent of 13%. Consumption of oil was not increased. A table of relevant data indicates an increase in m.p.g. from 2·8 to 3·9 compared with petrol, and a considerable saving in costs. H. G.

834. Possibilities of Creosote Oil for Omnibus Engines. D. E. Bell (Tramways, Light Railways and Transport Assoc.). *Gas World*, 1933, **98**, 655.—The direct use of creosote as a fuel involves addition to the engine equipment of an auxiliary tank for petrol, an additional carburettor and a special induction manifold. The use of creosote for commercial vehicles has passed the experimental stage, improved results being obtained by increasing the compression ratio. With modern engines the power output is comparable with that obtained from petrol throughout the speed range, but older types of engine show a definite falling off of power, when the engine speed falls below 700 r.p.m. The engine lubricant used must be a castor oil which should be changed every 2000 miles owing to the amount of base chamber dilution.

A table is given showing the relative running costs of various fuels.

W. A. W.

835. Combustion of Aromatic Hydrocarbons. A. Steimle. *Brenn.-Chem.*, 1933, **14**, 128–129.—A general discussion on the combustion of aromatic hydrocarbons as heating fuels, with special reference to coal tar oils. The amount of atomising medium, primary air required, is governed by the viscosity and chemical constitution of the oil to be burned, rather than by the quantity of oil. The use of burners wherein the supply of atomising air, primary air, is intercontrolled with the supply of combustion air, has led to the belief that coal tar oils are inferior, unusable, which is by no means the case. A modified burner design is illustrated, which provides an auxiliary passage for the primary air supply, the flow through which is not affected by the throttling of the combustion air supply. The importance of the siting and cone shape of the burner nozzle is emphasised. B. C. A.

836. Charcoal-Gas Automobile. Anon. *J. Fuel. Soc.*, Japan, 1933, **12**, 68.—A portable charcoal-gas producer for use with automobile engines has been designed at the Imperial Fuel Research Institute, Japan. The producer is of the down-draft type and is so arranged that no steam is transmitted to the vaporising zone. It can be fitted to an ordinary motor car at a reasonable cost. Road tests under various operating conditions indicate that the torque produced is nearly the same as that with gasoline and a speed of 45 m.p.h. can be obtained on a concrete surfaced road. The cost of the fuel is one-fifth that of gasoline. G. R. N.

837. Bitumen Emulsions. A. Caroselli. *Bitumen*, 1933, **3**, 106–110.—The history of the development of bitumen emulsions is traced. The constituents of the latter are indicated and stress is laid upon the importance of resisting

the action of freezing temperatures. A brief outline is given of the behaviour of these preparations upon roads. Finally, mixing-bitumen emulsions are mentioned and a new type of emulsion prepared with water—insoluble organic emulsifiers which, however, swell in water. These emulsions are miscible without decomposition with any grade of stone, with quartz sand, and with cement. After drying, the mixtures prepared with these emulsions are absolutely water-tight even under the prolonged action of water. They are specially suitable for the mixture-process, but can also be used on roads (especially in dry weather) and for other purposes.

In contrast to the usual type of emulsion (containing water-soluble emulsifier), a pervious layer, equally distributed over the stone, is formed, instead of a continuous impermeable coating. As the water evaporates, the bitumen particles coalesce in such a way that the full adhesive properties come into play. C. C.

838. Cold Tars. H. Mallison. *Gas J.*, 1933, **202**, 862–864; *Gas World*, 1933, **98**, 674–675. (Report before Inst. Road Tar Conf., Lucerne, 1933).—Confusion has existed with regard to the nomenclature of cold liquid binding materials; the tar industry in Germany has therefore distinguished between cold tars, which acquire their binding properties by the evaporation of volatile oil, and tar emulsions which lose water. The asphalt industry has also recently made a similar distinction between bitumen-emulsions and cut-back asphalts.

It should be possible to apply a cold liquid binding material in any season without heating and this result can be achieved either by selecting a very fluid tar or by adding large quantities of solvent to a viscous tar. A fluid tar, however, is very slow in attaining binding power, and a tar with a high percentage of solvent lacks binding material; it is therefore necessary either to use a tar which is sufficiently fluid in the summer, but requires heating in the winter, or to employ two grades of tar according to the season. The purpose for which the tar is intended, the means of application, and economic considerations will be the deciding factors as to the tar employed.

The German specifications for Cold Tars Nos. 1 and 2 are given. Consistency is determined with a consistometer having a 4 mm. nozzle instead of the 10 mm. nozzle used for hot tars, the dividing limit between the two tars being a consistency of 20 secs.; tars having a consistency of 20 secs. or under can be sprayed at temperatures below 30° C. without heating. The most viscous cold tar is approximately the same as the thinnest standard hot tar. The rate of evaporation of the solvent is determined at various temperatures on 50 gms. tar, and the consistency of the residue examined by the Ubbelohde method. Several methods of estimating the binding power are described. A belief is held that cold tar must bind as quickly as possible, but, according to the author, the rate of binding must be varied. A cold tar used for restoring an old tarred surface must be rich in oil and will therefore not pass the binding test.

The only other country having similar specifications is America; the viscosity range in these is of the same order as in the German specifications, but the tars are sub-divided into a number of groups within this range.

A. O.

839. Filled Tars. P. Le Gavrian, D. Boutet, G. Bedaux. (Report before Int. Road Tar Conf., Lucerne, 1933.) *Gas J.*, 1933, **202**, 861; *Gas World*, 1933, **98**, 675.—A brief reference is made to practical experiments, carried out in France, with coal and Wizerne limestone as fillers for tar. The results obtained confirm the assertions made by Leauté and the theories expressed by Evans and Pickard. (Abstr. 1237, 1931.) A. O.

840. Tar Concrete. W. E. Cone. *Gas J.*, 1933, **202**, 864–865; *Gas World*, 1933, **98**, 672–674.—In the design of tar concrete mixtures a knowledge of factors controlling resistance to displacement, durability and safe surface is essential. The problems involved are discussed in some detail.

The mixture should be designed on the principle of the densest mix of evenly graded aggregates with sufficient tar to fill the voids in the compressed aggregate. Reasonable values for durability and stability are more usually obtained with medium void mixtures. Practical experiments carried out some years ago using aggregate from ¼-in. down to filler, with varying proportions of high consistency tars and soft pitches, revealed a tendency to crack under low temperature conditions, and a liability of the surface to become highly polished. Partial softening of the pavement during hot weather and heavy traffic was responsible for slight distortion and wave formation. With mixtures on tarmacadam the instable base course contributed to cracking and disruption of the wearing surface. Owing to the weakness of two coat work, due to imperfect bonding between two structures of dissimilar characteristics, the author attempted to design a satisfactory single coat mixture. A series of experiments resulted in a mixture consisting of evenly graded aggregates from 1 in. to filler and a soft pitch. The filler was limited to 5% and the natrux to 8–10%, depending on void content of aggregate. This mixture was not quite satisfactory on a base course of tarmacadam, but laid direct on the foundation better results were obtained.

Aggregate for tar concrete should consist of angular particles free from deleterious matter and possessing toughness and resistance to abrasion. At least 75% of the filler should pass a 200-mesh sieve.

The various sizes of aggregate should be heated to 230–260° F., and mixed with soft pitch at same temperature. Filler should be added during mixing.

If necessary a seal coat of tar complying with B.S.S. No. 76, 1931, Tar No. 3, may be applied. A. O.

841. Tar for Roadmaking. Institution of Mining Engineers, Memo. No. 11 (Utilisation of Coal Committee). *Quarry and Roadmaking*, 1933, **38**, 263–264.—About 12 gallons per ton of coal, with an annual production of about 1,100,000 tons of tar, are obtained at gas works, while 7 gallons per ton of coal, with an annual production of about 680,000 tons, are obtained from coke ovens in Great Britain. The tar is sometimes refined locally, but is usually delivered to tar distillers for blending, since more suitable products can be obtained in this way. The principal products are road tar, pitch and creosote, the crude tar being dehydrated and "topped" to obtain road tar, or reduced to about 50% for pitch.

Figures are given for production, home consumption and export of tar, together with figures for imports of bitumen into Great Britain for a number of years. Specifications issued in 1911 by the Road Board did not provide for consistency, and therefore only served as rough guides. With increased demand for tars closer supervision of manufacture became necessary, and the B.S.I. Specifications No. 76 for tars Nos. 1, 2 and 3 were issued 1930–1931.

Water and light oils in road tar are detrimental to road surfaces, and excess of naphthalene renders the tar granular when cold. Coke-oven tar is suitable for preparation of road tars, but vertical gas-retort tar contains a quantity of light oils and phenols, and horizontal gas-retort tars have high naphthalene content. No. 1 tar is used for surface spraying, Nos. 2 and 3 as binder for stone or slag macadam, and for grouting. The consistency of tar should be varied within the prescribed limits for all purposes. For grouting it should be as high as is practicable, whilst for spraying consistency can be relatively

low, though the tendency is to approach the upper limits in B.S.I. Specifications.

The most important properties of a road-making material are penetrability, adhesiveness and durability. A. O.

842. Wetting, Spreading and Emulsifying Agents for Use with Spray Fluids. V. Partial Phase Rule Investigation of a Miscible Oil System. R. M. Woodman. *J.S.C.I.*, 1933, **52**, 185–188.—There are four ternary systems possible from the components phenol, toluene, sodium oleate and water, and these have been investigated extensively and the equilibria tabulated. The quaternary system has also been examined to some extent. The presence of water is necessary to obtain miscible oils containing more than a small percentage of emulsifier, and the practically important oils are four—and not three—component systems. E. B. E.

843. Patents on Kerosine. Lampen and Metallwaren Fabrik A.-G. E.P. 393,083, 1.6.33.—A burner for use with wick-fed lamps enabling widely varying flame sizes to be obtained without soot formation. A device is provided for covering and forming a chamber surrounding the burning surface, both device and wick being movable relative to one another.

Perfection Stove Co. E.P. 393,121, 1.6.33.—Improvements in tubular wick burners whereby seepage due to condensation of heavier fractions on the cool wick tube is avoided, together with consequent dripping from the burner. This is brought about by making the air-controlling member take the form of two nested concentric collars thus ensuing a high wick-tube temperature. S. B.

T. Penberthy. E.P. 393,599, 6.6.33.—A vaporising device for use with burners of lighting and heating lamps. W. H. T.

844. Patents on Engines. Ethyl Gasoline Corporation. E.P. 392,998, 1.6.33.—A compound for removing carbon deposits from cylinders. It consists of high boiling members of the furan family and morpholine (furfuryl alcohol) and an aromatic type of hydrocarbon boiling above 100° C. W. H. T.

ABSTRACTS.

Class 100. Geographic Occurrence.

845. Economic Aspects of Coal and Petroleum. R. Brunschwig. *Ann. des Comb. Liq.*, 1933, **8**, 209–276.—*Part I., Production.* Coal and petroleum account for more than 90% of the world production of energy. The figures for 1913 and 1929, calculated on equivalent calorific values, show a decrease in production of coal from 89% to 74%, while petroleum and natural gas increased over the same period from 6 to 17% and 1·5 to 4% respectively. Production and consumption figures of coal are given for 12 countries over a period of years. Similar figures for 25 countries are given for petroleum products; the consumption of petrol, kerosine, gas oil and lubricants are given separately. A chart shows the variation in production for nine American fields from 1926 to 1931. The question of reserves is discussed, and in this respect there would appear to be much greater reserves of coal than of petroleum, although accurate estimates are impossible.

Part II. Utilisation. General competition between coal and petroleum is discussed, particularly in U.S.A. The use of fuel oil in marine engines is rapidly replacing coal. The latter question is fully discussed, while a further section deals with the use of these products on land.

Finally, coal as a source of combustible liquids and petrols is discussed. In this connection the production of benzole, low-temperature carbonisation and catalytic hydrogenation under pressure are all mentioned, the latter being discussed at some length. The importance of developing co-operation rather than competition between these materials is stressed. C. C.

846. Petroleum Industry Throughout the World, 1932. *Mon. Petr. Roum.*, 1933, **33**, 255 *et seq.*—This is a series of articles giving statistical figures including production, consumption, imports, etc., for various countries, as follows (the page number being given in parenthesis): Czechoslovakia (255); U.S.A., Russia (355); Venezuela, Persia, Dutch Indies, Mexico (409); Poland (471); Columbia (527); Argentine (528); Trinidad (529); Peru (530); British India (531); Japan, Sarawak, Germany, Egypt, Irak (733); Canada, France, Ecuador (801). C. C.

847. Statistics. G. Sell. *J. Inst. Petr. Techn.*, 1933, **19**, 673–677.—A brief tabulation of figures for the world production of crude petroleum, the world consumption of motor fuels, the production of crude petroleum and motor fuel in U.S.A., and the imports of petroleum and its products into the United Kingdom for the years 1930, 1931 and 1932. G. R. N.

848. Nomenclature for Petroleum and Mineral Oil Products. P. Schwarz. *Petr. Zeit.*, 22.7.33, **29** (29); *I.P.K.* Reprint, 1884**2**, 1–4.—The author deals with the attempts of standardisation made by the American Society for Testing Materials, the German nomenclatures suggested by Prof. Dr. von Hoefer and the International Tariff Union. The equivalents of mineral oil and petroleum products are given for 20 different countries and arranged in a concise tabular form. W. S. E. C.

849. France and National Refining Industry. M. Filhot. *Refiner*, 1933, **12**, 250–255.—A law enacted in 1863 stipulated that all crude oil introduced into France to be refined should be free of duty, gasoline imported as such to be subject to a tax of 10 francs per 100 kilos. Successive reduction of the protection to a final value of about 1 franc in 1903 caused the abandonment of the industry. In 1919 a further law was enacted exempting refiners from

duties except on refined products, but failing in its objects further privileges were granted in 1928, amounting to Fr. 105 per 1000 litres of gasoline and kerosine and Fr. 330 per metric ton of lubricants. Further in lieu of the normal three-year import permit conceded to the regular importer of foreign oil products, the issue of a 20 year permit based on the quality of oil products extracted from imported crude and to be sold on the domestic market was instituted.

On this basis licences were issued to eleven conceurs, covering the importation of 4,846,000 tons approximately of crude oil per annum. In April, 1933, eight refineries were in operation, and several others are due to be completed and in operation before the end of the year.

It is claimed that the obligation to buy constructional material as far as possible of French manufacture, the quality of French operating personnel and the necessity of submitting to customs supervision have not proved prejudicial to the success of constructional and refining operations.

B. C. A.

850. Quality of Rumanian Petroleums. E. Severin. *Petr. Zeit.*, 15.7.33, **29** (28), 13–16.—Petroleum occurs in Rumania in all sedimentary formations from Cretaceous to early Pliocene. The region extends from Maramures and Bukowina to Oltenia. The most important area in the sub-Carpathian zone is situated between the valley of Tratus and Jalomitza, then follow those of Buzau, Prahova and Dambovitza.

Some Rumanian crude oils yield 30% of benzine, and most of the benzines obtained are knock-free and contain a large quantity of aromatic hydrocarbons.

The crude oils can be classified into two groups :—

(*a*) Light and paraffinic crude oils (60%) of sp. gr. 0·787—0·845 at 15° C.; and

(*b*) Heavy and paraffin-free (40%) of sp. gr. 0·845—0·911 at 15° C.

The Moreni region produces most petroleum. The sp. gr. of the crudes from this region vary considerably, that of Astra Romana being 0·7943 and of Credit Minior 0·9216. The crude oils are arranged according to the chemical analyses. The paraffin-free oils are subdivided into light, medium and heavy grades, the paraffinic type being much more homogeneous.

In general, the chemical composition of the oils vary with the geological layer. They can be classified into the four following main divisions according to the layers and domains :—

(*a*) Petroleum from Moreni (Meotic layer) and from Baicoi (Dacien layer) containing 4% of light aromatic hydrocarbons.

(*b*) Those from Moreni (Dacien layer), Gura-Ocnita, the same layer of the range Arbanasi (Meotic) containing 2·5% of light aromatic hydrocarbons.

(*c*) Those of the Oliocene of Solontz, Moinesti, Semes, Bustenari-Gropi and Runcu containing 1–1·5% of light aromatic hydrocarbons.

(*d*) Those of other strata containing less than 1% of light aromatic hydrocarbons.

The percentage of aromatic, unsaturated, naphthenic and paraffinic hydrocarbons in the various fractions is given in tabular form.

W. S. E. C.

851. Prospects of Lok-Batan Field (Russia). I. Gubkin. *Oil News*, 1933, **33**, 512–513.—This oilfield is closely linked with a question of great theoretical and practical importance, *i.e.*, the question as to whether it is possible to find oil on the slopes of mud volcanoes ("sopki") which are so plentiful in the south-eastern part of the Caucasus. A close connection appears to exist

between the richest Soviet oilfields and mud volcanoes. The question is whether the mud volcanoes are the result of the presence of oil or vice-versa. The author explains the divergent views regarding the origin and nature of mud breccia. One view is that the breccia is the result of gas explosions and consequent destruction of crater rocks, whilst the second view is that the breccia is formed by the sliding of complex strata one over another which causes rubbing and hence produces the breccia. Whereas the first view advocates the drilling of such areas, the second opinion is that such a procedure would be a waste of time. From the results obtained in the Lok-Batan field, which the author describes, it appears that the first view is correct, since Well No. 45, a tremendous gusher, was drilled in a volcanic area. The possibility of rich oil areas being found in this part of the Caucasus is considered to be distinctly promising. W. E. J. B.

Class 200. Geology and Origin.

852. Theories of McKenzie Taylor on Base Exchange in Clays and the Geology of Petroleum. J. Jung. *Ann. des Comb. Liquides*, 1933, **8**, 291–300.—The question of base exchange in clays is first discussed from the point of view of the geology of petroleum. Clays can be permeable or impermeable according to the impregnating liquid. Sodium clays are permeable in a saline medium, but impermeable after a fresh water wash. Calcium clays remain permeable.

A summary is given of the work and theories of Taylor upon the geological history of petroliferous areas and the connection with a bacteriological origin of petroleum (*J. Inst. Petr. Techn.*, 1928, *et seq.*). Experiments carried out by L. C. Case (*Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 66) confirm the results of Taylor, but the latter's theoretical deductions are criticised.

While it is generally accepted that petroleum is a product of transformation of organic material, probably unicellular algæ, the mechanism of the change is less generally agreed. The author favours the theory that it is a fermentation action, and considers that Taylor's theory supports this conception. C. C.

Class 300. Development and Production.

853. Small Vacuum Pump Supplies Required Pull on Sand without Excess Power Demand. R. D. Reed. *Oil Weekly*, 10.7.33, **70** (4), 16.—The problem of keeping the small stripper lease under vacuum with small expense has been solved in the Kansas District.

A small pump, which was capable of putting a strain of not more than 1000 lb. on the rammer, which would move 1500 cu. ft. of gas in 24 hours with an 18 in. stroke 20 times per minute, and which would be inexpensive to produce, was installed.

This pump was securely anchored in such a position that it could be connected to an eccentric of the power with a rammer made of 2 in. tubing. As a precaution against a possible freeze-up or failure to open an essential valve, a safety valve was installed on the pressure side of the pump, while a vacuum gauge shows the efficiency with which the pump is working. L. V. W. C.

854. Operating Characteristics Govern Selection of Prime Movers for Pumping. H. Vance. *Oil Weekly*, 17.7.33, **70** (5), 41.—In order that natural flow conditions may be maintained for as long a period as possible, it is essential that the fluid in both the tubing and casing be kept alive.

If there is any doubt that the well will not flow through the casing, the pressure should not be released, as there are methods by which the dead oil column at the back of the tubing may be partially removed and replaced with fresh oil. Where the casing pressure drops with a drop in tubing pressure, it is sometimes possible to build up the tubing pressure after the well has started to flow through the tubing, so that the flowing pressure throught he tubing is 30 to 40 lb. higher than the closed—in casing pressure. Fresh oil can thus be added at the top of the annular space between the casing and the tubing by injecting part of the flow from the tubing into the casing.

Good results have been obtained by flowing the well twice a day, that is half the allowable at each period of flow.

Wells with short flow lines and separators set at the well with gravity flow to the tanks can be kept alive longer than wells having long flow lines and a central separator, due to elimination of back pressure.

A wide range of equipment is available for wells to be put on the pump and the type of prime mover should be selected only after a careful study has been made of the requirements of the particular property. L. V. W. C.

855. Down Stroke Conditions Greatly Affect "Below Ground" Efficiency. R. R. Robinson. *Oil Weekly*, 17.7.33, **70** (5), 49.—Defects which produce large power losses and higher maintenance charges can be eliminated with very small investment.

Lack of sufficient counterbalance, improper stroke and speed for the pump and improper selection of the pump for the stroke and speed used are the most common defects.

The number of r.p.m. is the factor usually measured, but speed variation during single stroke is often more important in its effect on pumping. In addition the rods and plunger are moving at a continually varying velocity and they may not be moving at the same velocity as each other. Generally they are moving at different velocities and in different phase relation.

With slow speed wells of approximately the same depth and loading, the operating characteristics are almost identical.

At the higher speeds differences appear, the inertia effects varying as the square of the speed.

Any difference in load due to inertia affects the length of the plunger stroke. In fact a variation in pumping load will produce a change in the whole stroke and load relation.

With an underbalanced well the speed of the plunger increases during most of the downstroke. At the mid-point of the stroke the rods will move down at the top faster than the plunger below can move under its own weight. This results in a buckling of the rods. During the upstroke the dynamometer card shows the ideal parallelogram where the rods and the plunger can fall at the same speed the best operation will be obtained. There will be no buckling and the plunger will make its complete downstroke.

The speed at which the plunger can drop determines the manner in which the pump will operate.

Many factors will control the speed of fall, but the plunger must always have time during the downstroke of the rods to drop to its full extent. Any loss in the drop of the plunger means a corresponding loss in efficiency.

L. V. W. C.

856. Fundamental Considerations in the Selection of Pumping Equipment. J. S. Hudnall. *Oil Weekly*, 17.7.33, **70** (5), 28.—The flowing life of the East Texas Field will be such that about 500 wells per month are expected to be added to the pumping list. Those wells which will go on the pump first are

in the thin sand areas in the densely drilled areas and along the Gladewater uplift. New pumping wells will in general be grouped around those wells already pumping.

The salt water problem in the field is small at present, but should encroachment of this water become rapid, a plan whereby it is returned to the producing sand is thought to be practicable.

Expense can be saved by following the classification of pumping equipment shown on a map which accompanies the article. L. V. W. C.

Class 400. Transportation, Storage and Distribution.

857. Construction of a Marine Oil-Loading Station. T. F. Davey. *Engineering*, 1933, **136**, 27.—This interesting article describes the construction and layout of a crude oil storage and export base situated in the marine oilfields on the Californian Pacific Coast. The oil was loaded into the tankers through a 10-in. sea loading line. This line was 2500 ft. long and the author describes in detail the methods of its launching, testing and general working. The cost of the line and anchorages was £11,000. W. E. J. B.

858. Electrolytic Corrosion in Gas Mains. W. Beck. *Gas World*, 1933, **98**, 584–594.—Experiments are described in which measurements with a metallic search electrode were made on the surface of a pipe carrying on electric current and embedded in soil or immersed in liquids.

A number of new pipe coverings exposed to the influence of electric currents, low temperature and vibration stresses were also examined and results are given in curves and tables.

Amongst the coverings examined was a bitumen of 60/70° C. K. & S. Softening Point. There were also rubber-paraffin compounds, paints, etc. A. O.

See also Abstract No. 909.

Class 500. Properties and their Determination.

859. Vapour-Liquid Equilibria of Hydrocarbons at High Pressures. W. K. Lewis and C. D. Luke. *Ind. Eng. Chem.*, 1933, **25**, 725.—Curves for the correction factor for the gas laws, applicable to hydrocarbons with more than 3 carbon atoms per molecule have been corrected in minor details and corrections have been made to the generalized fugacity plot. The results of preliminary experimental work of the volatility of benzene in nitrogen at high pressures have been indicated tentatively on the fugacity plot as a means of estimating the volatility of high-boiling hydrocarbons at high pressures. The correction factor for the internal energy of hydrocarbon vapours at low vapour volumes has been determined by graphical integration from the isometrics of those hydrocarbons for which adequate data are available. The resulting corrections appear to be relatively independent of the temperature, at least over considerable ranges. Differences in the correction for hydrocarbons having more than 3 carbon atoms per molecule are probably small at corresponding reduced conditions. W. H. T.

860. Vapour-Liquid Equilibria for *n*-Hexane-Benzene Mixtures. C. O. Tongberg and F. Johnston. *Ind. Eng. Chem.*, 1933, **25**, 733.—Pure *n*-hexane has been obtained from petroleum by fractionation and removal of the remaining benzene in the distillate by nitration. It has also been

obtained from a mixture of *n*-hexane and benzene by distillation with *tert*-butyl alcohol. Equilibrium data for mixtures of *n*-hexane and benzene have been determined and, contrary to the evidence reported in the literature, it has been found that *n*-hexane and benzene do not form a constant-boiling mixture, but that enrichment of the vapour practically ceases at concentrations below 3·5 mol. per cent. benzene. W. H. T.

861. Vapour Pressure of Low-Boiling Paraffin Hydrocarbons in Absorber Oil. G. L. Matheson and L. W. T. Cummings. *Ind. Eng. Chem.*, 1933, **25**, 723.—A diagram and details are given of an apparatus developed for the static determination of vapour-liquid equilibria. It is a modification of that of Calingaert and Hitchcock, provision being made for the agitation of both phases. Agitation ensures uniform composition of the phases and enables equilibrium to be reached in the minimum time. The vapour pressures of *n*-butane, *n*-pentane, *iso*-pentane and *n*-hexane have been determined over a wide range of concentrations and the results compared with those obtained by calculation from Raoult's law. All the paraffins examined show a positive deviation from Raoult's law and the deviations when plotted against concentration in the absorber oil fall on a common curve. The curve for *iso*-pentane is similar to that of the normal paraffins, but lies above it. The pressure deviations of the normal paraffins expressed as a percentage of the value calculated from Raoult's law were found to be approximately the same at a given molal concentration and temperature. The practical effect of the positive deviation from Raoult's law of the light hydrocarbons dissolved in the absorber oil is that at a given total pressure an absorption tower will remove less light hydrocarbon from the inert gas than would be calculated by Raoult's law. W. H. T.

862.—High-Pressure Rectification. II. *n*-Pentane–*n*-Heptane System.—L. W. T. Cummings, F. W. Stones and M. A. Volante. *Ind. Eng. Chem.*, 1933, **25**, 728.—Dew point and boiling point curves have been determined for 3 mixtures of *n*-pentane and *n*-heptane, from a pressure of 6 atm. through the critical region. Vapour and liquid densities have also been measured at the two-phase boundary. Several constant-pressure, vapour-liquid diagrams have been determined from the data obtained and their applicability to the problem of high-pressure rectification is pointed out. W. H. T.

863. Effect of Gasoline Volatility on Miscibility with Ethyl Alcohol. O. C. Bridgeman and D. W. Querfeld. *Bur. Stand. J. Res.*, 1933, **10**, 841–850.—In a previous paper by the same authors, "Critical Solution Temperatures of mixtures of Gasoline, Ethyl, Alcohol and Water," *Bur. Stand. J. Res.*, 1933, **10**, 693, experimental results were given which indicated that differences in the volatility of the various gasolines examined might account for the differences found in the critical solution temperatures with ethyl alcohol.

In continuation of this work samples of gasoline having different volatilities were obtained (*a*) by fractional distillation of an original gasoline; (*b*) by the blending of refinery and natural gasolines.

The more volatile gasolines were found to be more miscible with the alcohol, producing mixtures with lower critical solution temperatures than similar mixtures with less volatile gasolines.

On the other hand differences between the critical solution temperatures of mixtures containing gasolines of the same volatility but of different composition were found to be relatively small.

Tables containing full experimental data as well as a number of curves are included in the paper. D. L. S.

864. "Four-Ball" Testing Apparatus for Extreme-Pressure Lubricants. G. D. Boerlage. *Engineering*, 1933, **136**, 46.—Increased pressure on and speed of the surface of gear teeth demand special E.P. Lubricants. The requirements for these oils are fundamentally different from those of normal lubricating oils; heavy load gear wheels, necessitating E.P. lubricants, operate with pressures of 100,000 lb./sq. in., which is about four times the pressure in normal gear wheels and 25 times greater than the pressure on a gudgeon-pin bearing surface.

An original design was later modified so that two cylinders rotated with their axes at right angles. Temperature at point of contact could be measured and the revolutions per minute could be varied, etc.

The "Four-ball" apparatus is simple, easy to manipulate; results are obtained rapidly and cheaply, A weighted belt-driven vertical shaft having a cup-shaped lower end rests on a ¼-in. diameter ball bearing. This ball rests on three others arranged in the form of a pyramid, and the three balls are pressed tightly together by a conical ring, and on to the bottom of a cup which retains the oil under test and the balls. The upper ball therefore has three points of contact, one with each ball. The shaft is rotated and the friction of the balls tends to rotate the oil-containing cup which rests on a table supported on ball bearings. The torque on this table is measured by a spring dynamometer.

The quickest and most easily obtained results were secured by determining, at a given speed, the highest pressure that a certain oil would stand for a run of one minute without permitting the balls to seize. The best mineral and fatty oils will not stand an applied force of 150 kg., whereas E.P. lubricants would easily stand 300 kg.; specially prepared oils withstood as much as 800 kg. In some experiments at 1500 r.p.m., too high an applied force welded the four balls firmly together.

Dynamometer curves show that the torque rises rapidly immediately after the apparatus starts up. It then decreases and keeps constant for some time unless seizure begins, which is indicated by a sudden rise of torque.

E.P. lubricants are remarkable because they prevent seizure of the balls under pressures that are higher than the balls would stand mechanically without permanent deformation. C. I. K.

865. Durability of Oil-Films. J. Tausz and P. Székely. *Erdöl u. Teer*, 1933, **9**, 331–332.—Difficulties arise in measuring thicknesses of oil-films between metal surfaces owing to the impossibility of obtaining perfectly plane surfaces. These have been surmounted by the use of mercury in place of one of the metal plates. The apparatus used consists of a 2-cm. diameter steel ball immersed to a depth of 0·8 cm. in a bath of mercury. A drop of oil is introduced on to the surface of the mercury, before immersing the ball. The hydrostatic pressure tends to form a very thin film of oil around the ball, viscosity tending to maintain the oil in position.

The thickness of the film is measured electrically, by means of a Wagner-Wertheimer capacity bridge, the ball and mercury forming the plates of the condenser, and the oil the dielectric.

A number of oils have been examined in this way, the viscosity, the resistance after a given time and the film thickness attained, together with information as to whether or not the film has broken, being recorded in tables.

In periods of up to 1300 minutes, it was found that only aromatic-base oils showed a breakdown of the film.

Naphthene base oils were very stable, even a gas-oil standing-up for 1560 hrs. and attaining a film thickness of 0·029 μ. An aromatic gas-oil of twice the viscosity broke down in a few minutes.

A cylinder oil attained a thickness of about 0·4 μ after 195 hrs. without breaking. Castor oil gave 0·115 μ film thickness after 918 hrs. without breakdown. The work is being extended. E. B. E.

866. Viscosity Index and other Properties of Pennsylvanian Oils. M. R. Fenske. *Nat. Petr. News*, 5.7.33, **25** (27), 33–36.—An analytical vacuum distillation apparatus operating at an absolute pressure of 0·05 to 0·1 mm. Hg. and so designed that a pressure drop of less than 1 mm. Hg. occurs in the column has been used on a number of Pennsylvanian oils. Fractions having a distillation range, by the Engler vacuum distillation method, of less than 10° C. have been produced. Tables show that the oils have a very uniform and regular variation in properties as the boiling point increases. It is submitted that this investigation indicates the desirability of the development of solvent extraction processes to produce from Pennsylvanian oils the closer "fractionation" which is necessary to improve such properties as viscosity index. H. G.

867. Gasoline Engines and Knock Testing. R. Stansfield. *J. Inst. Petr. Techn.*, 1933, **19**, 567–573.—A brief discussion of the progress in the design of gasoline engines and a concise account of knock-testing developments during 1932. G. R. N.

868. Chemistry of Petroleum. D. A. Howes. *J. Inst. Petr. Techn.*, 1933, **19**, 655–672.—A review of literature published throughout the year on the chemistry of crude petroleum, shales and shale oil and oil field waters, the preparation of pure hydrocarbons, the chemistry of cracking and pyrolysis, sulphur compounds, the oxidation of petroleum hydrocarbons, and asphalts and pitches. G. R. N.

869. Is there a "True" Flash-Point? S. Erk. *Erdöl u. Teer*, 1933, **9**, 317–318.—Erk continues the controversy with Baader on the meaning and nature of flash-point determinations. Erk thinks that the flash-point is purely a conventional value depending on the method of determination, and not a fundamental property of a material.

In a reply Baader maintains his previous views, and rejects Erk's arguments. E. B. E.

870. German Development in Flash-Point Testing. Schlüter. *Erdöl u. Teer*, 1933, **9**, 319.—Schlüter supplies further information on his design of apparatus with reference to a recent historical survey of the subject by Baader. E. B. E.

871. Thermal Decomposition of Organic Compounds. III. Calculation of Products formed from Paraffin Hydrocarbons. F. O. Rice, *J. A.C.S.*, 1933, **55**, 3035–40.—The mode of thermal decomposition of paraffin hydrocarbons is discussed, on the assumption that the reactions occur by formation of olefines, free radicles and hydrogen, according to a chain mechanism. Typical examples are given and it is shown that the amounts of the various decomposition products can be calculated with a very fair degree of accuracy, assuming this mechanism, and also that the relative chances of reaction of primary, secondary and tertiary hydrogen atoms are 1 : 2 : 10 respectively. E. B. E.

872. Relation of Anti-knock Value of Gasoline to its Volatility and Solubility in Liquid SO_2. H. T. Ward and A. H. White. *Oil & Gas J.*, 1.6.33, **32** (2), 38.—A new apparatus has been designed to provide a rapid and simple method for the extraction of liquid materials with SO_2. This is fully described

and illustrated. The method of operation is to bubble SO_2 into the material to be extracted which is cooled in a burette to —20° C. The SO_2 condenses and settles to the bottom of the burette with the extracted material and forms a layer which is separated from the oily layer above by a distinct line of demarcation and may be measured and drawn off readily. Three extractions are made before the unextracted material is drawn off, neutralised and measured.

Straight-run Naphtha from Pennsylvanian crude boiling between 228 and 418° F. was used as base material. Portions of this naphtha were oxidised in the presence of air at temperatures ranging from 400° C. to 710° C. Other portions of the naphtha were cracked in the same apparatus, but in the absence of air. The percentages extracted by SO_2, the octane numbers and A.S.T.M. distillation ranges were determined on all the samples of untreated, oxidised and cracked naphthas. The results are grouped according to origin and volatility. The oxidised samples showed a big decrease in octane number when stored for any considerable period, so tests were made within 2-3 days of preparation on such samples. Those oxidised gasolines produced at temperatures above 500° C. show a general realationship between octane number and percentage extracted by SO_2 when grouped according to 10% and 50% distillation temperatures, the octane number increasing with increase in solubility in SO_2. Cracked and untreated naphtha results are combined and also show a general relationship but the octane numbers of the cracked gasolines are considerably higher than those of the oxidised gasolines having similar solubilities in SO_2. It was, however, found that there was no general octane numbers/SO_2 solubility relationship for fractions of narrow boiling range prepared from untreated and oxidised naphthas. Oxidised naphthas produced at temperatures below 500° C. were also found to give no constant relationship between the two properties, and this is believed to be due to the presence of sufficient peroxides, even after a caustic wash, to depress the octane ratings of such products. In view of these results the investigation was extended to include a number of commercial samples of gasoline. These were graded according to 10% distillation temperatures when comparing the octane number/SO_2 solubility relationship, but whilst there is a trend towards higher solubility with increased octane number, except in the least volatile group, the results are not very consistent. There are also five exceptions to the volatility classifications in this group of samples.

R. A. E.

873. Comparison of Knocking Characteristics of Vapour Recovery and Natural Gasolines in Blends. H. M. Trimble. *Oil & Gas J.*, 18.5.33, **31** (52), 58.—In a paper read before the National Gasoline Association of America the author reports the results of tests carried out in order to investigate the relative anti-knock values of natural and vapour recovery gasolines having the same V.P., and the claims made that (*a*) the new method of test improves the relative value of natural gasoline, and (*b*) that natural gasolines and blends thereof possess a superior responsiveness to additions of T.E.L.

Six samples of vapour recovery gasolines were used and their compositions, distillation ranges, vapour pressures and A.S.T.M. and C.F.R. research octane numbers determined. Each gasoline was then fractionated to a butane-free condition and tested for distillation range, vapour pressure, octane number by A.S.T.M., C.F.R. Research and Ethyl Gasoline Corporation (E.G.C.) methods. The T.E.L. requirements in ml./gal. for octane numbers of 80 A.S.T.M. method 80 and 85 E.G.C. method were also determined. Octane number ranges were: A.S.T.M. 68/73, C.F.R. Research 71/79, E.G.C. 74/81, and T.E.L. requirements for 80 octane number were: by A.S.T.M. method 2·15/6·0 ml., by E.G.C. method 0/0·8 ml. The butane-free vapour recovery

gasolines were then blended in equal quantities and samples having V.P.'s of 14, 18, 22 and 26 lb. prepared by blending in appropriate quantities of blended light fractions obtained from the original gasolines when debutanising. Taking one sample of 26–70 natural gasoline, samples of vapour pressure similar to those prepared from the composite vapour recovery gasoline were prepared by similar means. The two series were then examined for composition, vapour pressure, distillation range and octane numbers A.S.T.M. and C.F.R. research methods. The characteristics of each range of samples show a regular gradation with change in V.P. and the octane number ranges are: vapour recovery gasolines, A.S.T.M. 70·8/79·3, C.F.R. Research 74·8/83·2: Natural gasolines A.S.T.M. 64·9/79·2, C.F.R. research 65·5/76·5.

Three heavy gasolines of low V.P. and differing in nature and T.E.L. response were next tested for distillation range, octane number by all three methods, and T.E.L. requirement for various standards by E.G.C. and A.S.T.M. methods. Each heavy gasoline was then blended with each of the composite blends of natural and vapour recovery gasolines to give a final product of V.P. 11/11½ lb. Reid. The distillation ranges, octane numbers by all three methods, T.E.L. requirements for 70 and 78 octane number by E.G.C. method, and 70 octane number and the equivalent of C6 fuel by A.S.T.M. method were determined. All of these results are tabulated and illustrated graphically to show percentage composition of the mixtures.

In all instances the difference in A.S.T.M. octane number between natural gasoline blends and vapour recovery gasoline blends, each containing light gasoline of the same V.P., is appreciably less than the difference in S.30 octane numbers of the same blends, and generally less than the difference in C.F.R. research method octane numbers of the same blends. The natural gasoline blends always have a lower octane number than the corresponding vapour recovery gasoline blends. The T.E.L. requirements of the natural gasoline blends to the new Ethyl standard by A.S.T.M. method are, however, in all cases lower than those of the corresponding vapour recovery gasoline blend, whereas the reverse is generally true for the old Ethyl standard by the S.30 method. T.E.L. requirements for the new Ethyl standard are appreciably increased as compared with the old standard and method, except for natural gasoline blends with a straightrun heavy gasoline. Other interesting comparisons are made and T.E.L. requirements for "Q" gasoline of the various blends are shown. Tests carried out on the butane free natural and vapour recovery gasolines show that to give the same increase in octane number as that obtained by the addition of 1 ml. of T.E.L. per gal. to natural gasoline, vapour recovery gasoline requires T.E.L. additions of (*a*) 2·5 ml. by S.30 method (*b*) 6 ml. by A.S.T.M. method.

The main conclusions are: (1) Octane numbers of vapour recovery gasoline blends are higher than those of the corresponding natural gasoline blend, irrespective of method of test, but the differences are appreciably reduced by the A.S.T.M. method; (2) Natural gasoline is much more lead responsive than vapour recovery gasoline, and by the A.S.T.M. method of test the T.E.L. requirements for Ethyl Standard of blends containing natural gasoline are less than those of vapour recovery gasoline blends. R. A. E.

874. High-Precision Determination of Iodine Values by the Wijs Method. L. J. P. Keffler and A. M. Maiden. *J.S.C.I.*, 1933, **52**, 242–245T.—In connection with the control of the purification of certain fatty acids (*e.g.*, erucic and brassidic), details of the Wijs method were worked out so that a precision of about four parts in a thousand could be obtained.

It is recommended that excess of iodine rather than iodine trichloride should be used in the preparation of the Wijs solution, as the latter is somewhat

unstable and volatile. Attention is directed to the large coefficient of expansion of Wijs solution, the standardisation of thiosulphate, the necessity for the use of carbon tetrachloride free from mercaptans and numerous other points of manipulation. A procedure for the recovery of used carbon tetrachloride is outlined. "Stabilised" starch solution was employed as indicator in the titrations; 0·6 grs. of salicylic acid, 1·3 grs. of starch and 500 ml. of water being used in preparing the solution, 2 ml. of which is added for a titration. E. B. E.

875. Thermal Behaviour of Sulphur Compounds in Hydrocarbon Solvents. II. Normal Butyl Sulphide in Benzene Solution. W. M. Malisoff and E. M. Marks. *Ind. Eng. Chem.*, 1933, **25**, 780.—The thermal stability of *n*-butyl sulphide in benzene solution has been studied by means of an improved furnace, at various temperatures, concentrations and times of exposure. *N*-butyl sulphide has been shown to be thermally stable in benzene solution at 400° C. for 50 secs. in 0·05 molal solution. Moderate decomposition occurs at 500° C., but even at 515° C. an exposure of 30 secs. only gives a 20% conversion. The sulphur-containing products of reaction at or below 515° C. up to 55 secs. exposure are only hydrogen sulphide and mercaptan. In the presence of large amounts of hydrogen sulphide, however, free sulphur and thiophenes are formed in addition. Rates of decomposition are less than those for the lower aliphatic mercaptans under similar conditions. Decomposition is wholly or partly heterogeneous, being definitely promoted by surface at higher concentrations (0·15–0·3 molal) and longer times of exposure (15–35 secs.). Aluminium oxide catalyses the reaction, the hydrogen sulphide yield being increased and mercaptan slightly decreased thereby. The inequality of rates of decomposition in benzene and in *n*-heptane suggests that in spite of its stability, the former may affect the velocity of decomposition or that the latter may be an inhibitor. W. H. T.

876. Analysis of Propylene and Cyclopropane in Mixtures containing Both.—S. Z. Roginski and F. H. Rathmann. *J. A.C.S.*, 1933, **55**, 2800–2805.—The authors needed a quick and reliable method for analysis of the mixture of hydrocarbons, when studying the kinetics of the thermal isomerisation of cyclopropane to propylene. Of the various methods tried, the best was found to be that involving absorption of the gas in aqueous bromine-iodine solutions. The absorption of propylene is very much more rapid than that of cyclopropane, and a satisfactory analytical separation was thus obtained. Curves are given showing the rates of absorption with different solutions.

Preliminary studies of the isomerisation have shown that the isomerisation is slow, but practically complete. For example, at 400° C. in 45 minutes, 44% of the cyclopropane was converted, while in 60 minutes, about 70% was converted into propylene. E. B. E.

877. Analysis and Testing. W. H. Thomas. *J. Inst. Petr. Techn.*, 1933, **19**, 636–651.—A review of the literature published during the year on the analysis and testing of solid, liquid and gaseous petroleum products. G. R. N.

878. Standard Methods of Testing Petroleum and Its Products. J. S. S. Brame. *J. Inst. Petr. Techn.*, 1933, **19**, 652–654.—A brief account of the year's activities of the I.P.T. committees on the revision of and the addition to the standard methods of testing petroleum. G. R. N.

879. Proposed Standard Laboratory Tests on Mineral Oils (Petrols, Kerosines and Fuel Oils). Italian Government Technical Committee. *Olii Min.*, 1933, **13**, 49–54, 65–69 and 84–85.—After a preliminary description of the

method and precautions for sampling, the various methods of test are outlined. These include the usual measurements: colour (Saybolt or Stammer), moisture, insol. in benzole, and Sp. Gr. at 20° C. In viscosity measurements, the Engler or Vogel-Ossag instruments are used. Descriptions of these viscometers are given and comparative figures for Kinematic, Engler, Redwood and Saybolt viscosities are given in a table for values from V_K 1·0 to 60·0. Above the latter figure, the conversion is given by

$$V_K = 7{\cdot}60\ E = 0{\cdot}245\ R = 0{\cdot}208\ S.$$

Fractional distillation is carried out by the Engler method, while closed flash points are obtained by the Abel-Pensky and Pensky-Martin instruments. The Marcusson apparatus is used for open flash points. For calorific values and sulphur determinations, the Mahler bomb is employed, the gases finally being exhausted through 3% hydrogen-peroxide solution to scrub out sulphur compounds. To obtain the setting point, acetone /CO_2 is used as the cooling agent in a Dewar flask. Organic acidity is found by titrating in benzole/alcohol mixture using alkali 6 B as indicator. Further tests include corrosiveness (copper dish) and hard asphalt. Aromatics are determined by first treating with sulphuric acid. After cooling, a mixture of 1 : 2 nitric and sulphuric acids is added and the separated layer read off (the Hess apparatus being used). Hydrogen sulphide can be detected, on boiling, by lead acetate, while carbon disulphide is qualitatively detected by phenyl hydrazine and is estimated by treatment with alcoholic potash, neutralising the aqueous extract with acetic acid and titrating with copper sulphate.

The Wijs method is used for iodine number.

In conclusion, detailed specifications are given for benzole (aviation), ethyl alcohol (for blending with petrol), aviation petrol, two grades of motor spirit, kerosine (as fuel, for agricultural purposes and for illuminating), petroleum ether (30–60° C.), extraction benzine, benzine for varnish and industrial purposes, normal benzine and various fuel oils (Diesel, light and residual fuels). C. C.

880. Use of Agulhon's Reagent in Analysis of Solvents. E. C. Craven. *J.S.C.I.*, 1933, **52**, 239–242T.—A slightly modified Agulhon's reagent has been used for detecting and estimating various alcohols and aldehydes, by the development of a blue colour under the appropriate experimental conditions.

The reagent used consists of a 0·1 N. solution of potassium dichromate, 4·9 gr. of the salt being made up to 1 litre with nitric acid (approximately 3 vols. of nitric acid to one of water). The method is adapted for volumetric work, titrations being carried out in ¼ in. test tubes. Generally a series is prepared with equal amounts of solvent and increasing amounts of reagent, allowing to stand for 5 minutes and then selecting the tube which just fails to reach full blue colour.

Acetone only develops a green colour after 6 hours standing. With half per cent. formaldehyde or ethyl alcohol a blue colour develops in a few minutes. Acetaldehyde and its polymers, higher aldehydes and alcohols and formic acid can also be estimated. Acetic acid does not give the reaction, nor do diacetone alcohol or mesityl oxide. In some cases heating on the water-bath for 5 minutes is recommended. The analysis of mixtures of, *e.g.*, methyl and ethyl alcohols can also be carried out. Considerable detail is given on the use and application of the method. E. B. E.

881. Simple Large Capacity Extractor. N. L. Drake and J. R. Spies. *Ind. Eng. Chem., Anal.*, 1933, **5**, 284.—This consists of a large capacity short-necked pyrex flask which is connected to the solvent boiler by means of a syphon tube. A breather tube is fitted inside the pyrex flask, which serves

as the extractor body, to promote clean syphoning. The circuit between boiler and extractor is completed by means of a vapour line, at the topmost part of which is fitted a condenser. An atmospheric condenser is attached to the extractor to ensure pressure equilibrium. Vaporisation of solvent in boiler is effected by a steam coil. This type of extractor was designed for processing ground roots or seeds, and although primarily for the use of methanol as solvent, with little change any solvent with boiling point below 100° C. could be utilised. R. E. D.

882. Analysis of Turkey Red Oils and Similar Products. Standard Wizoff Methods. *Oil and Colour Trades J.*, 1933, **84**, 94–98.—A series of discussions between various German associations have resulted in tentative methods being adopted for the analysis of these products.

Sulphonation is detected and the total sulphate estimated in the usual way by hydrolysis with HCl. Fatty acids are then obtained by extracting with ether, saponifying the residue and removing unsaponified matter with ether. The fatty acids are again liberated and extracted. Inorganic sulphate is determined gravimetrically by dissolving in a mixture of ether and amyl-alcohol and washing with sodium chloride solution in which the sulphate is estimated. Organically combined sulphate is obtained by hydrolysing with a definite amount of standard H_2SO_4 and titrating with standard alkali using methyl orange. A simple calculation gives the equivalent of the H_2SO_4 liberated from the ester group in mgm. KOH per gm. The degree of sulphonation is obtained by arbitrarily assuming the composition of the sulphuric ester to be ricinoleo mono-sulphuric ester.

The acidity is obtained by titrating in aqueous solution using phenolphthalein or, alternatively, the alkalinity may be determined. Neutral fat and unsaponifiable matter are extracted from an ammoniacal aqueous solution containing glycerine, with ether. The extract is saponified and the unsaponifiable removed by ether, the fatty acids then being liberated from the aqueous soap solution. Solvent is determined by steam distillation. Water is estimated in the usual way by distillation. Finally an approximation to the total fat content can be obtained by liberating the fat (in a Buchner fatty acid flask) with HCl at 100° C. The amount of fat can then be read off. C. C.

883. Crude Oil. W. H. Thomas. *J. Inst. Petr. Techn.*, 1933, **19**, 554–556.—Published work on the examination of crude oils during the year is briefly described. G. R. N.

884. Estimation of Paraffin in Crude Petroleum. R. Fussteig. *Matt. Grasses*, 15.7.33, (303), 9894–95.—Paraffin may be present in crude oil in solution or in the form of tiny crystals whose growth is inhibited by the presence of asphaltic or resinous matter. It can be separated by precipitation at low temperatures with the aid of a suitable solvent for the oil. If the precipitated paraffin is to be of high purity it is necessary to give the crude oil a preliminary treatment before precipitation. Methods involving destructive distillation of asphaltic matter are to be avoided, since some of the paraffin is decomposed. The author prefers the method in which the asphaltic matter is removed by treatment with fuming sulphuric acid. The crude oil is first mixed with light benzine then treated with the acid at 18° C. The bulk of the diluent is then distilled over, leaving an oil-wax mixture which, however, still contains certain bodies that inhibit the formation of large crystals. The paraffin is then precipitated by addition of a mixture of 1 part ethyl alcohol and 2 parts butanone containing 1% phenol. The latter dissolves the crystal inhibiting substances so that the precipitated paraffin is in the form of large crystals. The author

has compared this method with the alcohol-ether and butanone methods, using Boryslaw and Lipinki crude oils as well as synthetic mixtures of oil and paraffin; he finds it gives more accurate results and a whiter precipitate of wax. G. R. N.

885. Temperature Effect on Determination of Gum in Gasoline. O. C. Bridgeman and J. C. Molitor. *J.S.A.E.*, 1933, **33**, 283-290.—Further studies of the air-jet method for estimation of gum-content are reported. Various heating systems were used, *viz.*, steam-bath, air-oven and baths of different liquids such as tetralin, amyl acetate, water, and methyl alcohol.

It was found that the effect of evaporating different volumes of gasoline on the weight of gasoline obtained could be expressed by the equation $W=b(100+V)$, where W is the amount of gum formed per 100 ml., V., the volume of gasoline evaporated, and b, a constant for the particular gasoline. Evaporation in an air-oven at temperatures of from 70°C to 135°C appeared to have very little effect on the weight of gum obtained, which is explained by the facts that as the latent heat of the gasoline is high and the heat capacity of the air, low, the gasoline temperature probably does not vary much with the air temperature. Using different bath liquids in the apparatus developed by the General Motors Corporation, very large differences in gum yield were obtained, depending on the boiling-point of the liquid used. Length of time on the bath and time of drying also had considerable effects.

It was found that the influence of bath temperature on the yield of gum could be represented accurately by the equation,

$$\log[(G/G_{200})-0{\cdot}817] = -3+(1075/T),$$

where G is the gum content at any liquid bath temperature, G_{200} is the gum content using a tetralin bath and T is the bath temperature in absolute degrees centigrade.

Gum values by the tetralin bath method were found to be about 50% of those by the low-temperature air-jet method.

The conclusion reached as a result of the experiments is that the relative gum contents of two gasolines are independent of the particular volume evaporated and temperature conditions employed, so long as these are the same in both cases.

The selection of an air-jet method is, therefore, largely a matter of convenience. Preference is, however, expressed for the 200°C method (further work is necessary to indicate the most satisfactory bath-liquid), on account of the rapidity of the evaporation. E. B. E.

886. Crankcase Dilution. R. Levi. *Erdöl u. Teer*, 1933, **9**, 316-317.—The nature of the crankcase diluent in oils after use in the internal combustion engine has been investigated. A number of oils were examined after about 2,000 km. or more of use. The diluent was separated by (ordinary) steam distillation, the whole of the crankcase contents being employed. The amount of diluent varied from 3 to 10% of the oil, in different cases. In nearly every case the condensed water had an acid reaction.

The specific gravity of the diluent was about 0·790–0·800 and the boiling-range about 110° to 220°C. The "aromatics" (Kattwinkel number) varied from 33 to 40% and was apparently independent of the nature of the fuel used, whether benzole-mixture or straight benzine. The diluent reacts violently with bromine and oxidising agents and has a large gum-content. It probably contains dienes.

The author thinks that the finely divided carbon and perhaps also the polymerised products in the used oil are formed from the unstable constituents of the diluent. E. B. E.

887. Physico-Chemical Researches on Acidity of Aged Mineral Oils. E. Vellinger and A. Klinkenberg, *Ann. des Comb. Liq.*, 1933, **8**, 301–312.—The determination of the acidity of aged oils by the usual methods is difficult, owing to the dark colour. The authors use the antimony electrode and titrate potentiometrically (C.R. du Congrès du Graissage 1931) in alcohol/ether adding lithium chloride. Neutralisation curves are given for oils not highly refined both in the presence of deposit and free from the latter. Highly refined oils form a much higher proportion of acid on oxidation, but the less refined oils show a correspondingly greater deposition of sludge. The greater the deposit—the less the acidity, and *vice versa*.

The influence of temperature on saponification values of aged oils was studied. The total acidity (*i.e.*, free and combined) is then obtained by adding a slight excess of mineral acid (after saponification) and titrating. Neutralisation curves of this type are given. The ratio—total quantity of acid/free acid—is lower for highly refined oils (between 2 and 3) but it appears to be the same both for the sludge and for the oil.

Comparing this method of titration with the use of phenolphthalein, it has been found that the latter requires a slight excess of alkali to change. This may be significant with small values.

It is concluded that an error due to saponification may affect the acidity determination, particularly if the latter is prolonged. A considerable proportion of the acid formed on ageing is present, not as free acid, but in a saponifiable form. C. C.

888. Slope of the Viscosity/Temperature Function as an Important Criterion of Lubricating Oils. H. Umstätter. *Petr. Zeit.*, 9, 8, 33, **29** (31), 1–3.—A modification of Walther's viscosity formula which is given by the following equation log log η_x =A—B log T where η_x is the kinematic viscosity in centistokes, B is tan α the slope of the viscosity temperature curve, and T is the absolute temperature, has been applied and confirmed for 100 different oils using a Vogel-Assag viscometer. Angles can be obtained within 0°02 for tan α.

The slope usually decreases with increase of viscosity but oils of different viscosities giving the same slope do not correspond to the same index number. On the other hand oils of the same viscosity can have very different slopes. The anomaly of this can be shown by the following formula if log T is plotted against log. N (kinematic viscosity), tan α can be determined from the equation :—

$$\tan \alpha = \beta = \frac{\log \log \eta^1 - \log \log \eta}{\log T - \log T}$$

where T is $>T^1$ and $\eta^1 > \eta$.

Two viscosities determined at different temperatures give B.

Walther's formula is recommended in practice, namely, log log η plotted against log T (abscissal), η also being expressed in degrees Engler. The viscosities between 0 and 150°C. can be read, extrapolations being allowed up to 50°C. in case the set point lies below 20°C.

The change in viscosity due to temperature causes a loss in friction which increases with the slope of the viscosity-temperature curve of the lubricating oil and deviations from outside temperatures. The effect of viscosity is evaluated in the following equation :—

$N = 2F/r\ (\eta_0\, e^{Q/RT}\, C - \frac{E\ \gamma R)}{Q}$ where N is force of friction of the layer, F is the content of the surface layer, r is the thickness of the lubricating layer, η_0 the critical viscosity, Q the heat of cohesion, R the gas constant, T the

absolute temperature, C the integration constant, E the mechanical equivalent of heat and Y the specific heat. N is found to decrease in value with the decrease of the slope of the viscosity-temperature curve and is therefore a measure of the slope. W. S. E. C.

889. Examination of Bitumen Emulsions. Anon. *Asphalt u. Teer*, 1933, **33**, 482–483; *Annali dei lavori pubblici*, 1932 (6).—An investigation of emulsions has been undertaken by the Italian Mailand Institute. For emulsions, in general, the most important characteristics are particle size, tension between the particles, and the liquid, and the electric charge on the particles, and the protective layer. The mean particle diameter is obtained by a size-frequency curve. Italian commercial Emulsions have an average particle diameter of 2-3μ.

A formula is given—based on probabilities, for calculating the proportion of particles of any particular diameter :—

$$dN = N \frac{2}{a^3} \cdot e^{\frac{-2}{3} \cdot \frac{r^2}{a^3}} r^2 \cdot dr$$

where dN = proportion of particles of radius between r and r+dr,

N = Number of particles

a = most probable radius, i.e. 2a = mean diameter (If N = 100, dN—percentage).

Measurement of interfacial tension between bitumen and water must be carried out by intrapolation from figures obtained on solutions of bitumen in various solvents and water.

Bitumen emulsions, in particular, can be characterised by the curve showing the separation of water with time. The steepest curve usually corresponds to an emulsion with the least water separation, i.e., the greatest stability, while such an emulsion also gives the lowest value of 2a (or shows the greatest dispersion).

Tests required by specifications in different countries vary.

The composition of the emulsion is of special importance. Evaporation processes give unsatisfactory results as the recovered bitumen is altered. The most satisfactory method is the addition of the emulsion to 95% alcohol. A method which may be applied when the proportion of emulsifier is low, consists in precipitating the bitumen with barium chloride solution.

C. C.

890. New Processes for the Examination of Bitumen and Bitumen-Containing Mixtures. Part II. J. Greutert. *Bitumen*, 1933, **3**, 124–126.—A method is described for measuring the "flowing" characteristics of these materials. The apparatus consists of an iron plate 20 × 10 cm., to which is fitted a detachable framework which permits heated asphalt being poured to a level of 5 mm. over the plate. After cooling, the frame is removed and a 3 cm. strip cut off, leaving a layer of asphalt 17 × 9 cms. The plate is placed at an angle of 45° in a controlled oven and maintained at 75°C. or 100°C. for 20 hours. By a convenient device, 12 regular marks (3 rows of 4) are previously made on the surface of the asphalt, and the displacement of these marks enables a measure of the amount of flow to be obtained.

A second apparatus permits the degree of bending of asphalt plates under water-pressure to be examined (e.g., for asphalt-mineral mixtures for the bottom of canals). The sample is clamped in a ring above the lower half of an iron vessel with perforated bottom containing sand. The upper part of the vessel consists of an iron cover fitted with a manometer and 3-way cock. Water pressure to 1.7 atmospheres is slowly admitted and kept

constant 5-10 hours. The asphalt bends and rests on the sand. With plastic materials the curve is flatter. Cracks may be formed in the plate, and these are deeper for the less plastic materials which bend acutely.

Finally a device is described for testing the "sticking capacity" of cable compounds. The melted material is poured into a lead-lined cylinder made in two equal, separate, parts, to each of which a ring is fixed so that a tension can be exerted tending to pull the two halves apart. The apparatus, after filling, is maintained at 0° C. for 2 hours, and then the load evenly applied for 3 minutes. There are three typical cases :—(1) where cohesion exceeds adhesion and the mass pulls away from the mould ; (2) the material is ductile and the compound draws out before breaking ; (3) cohesion is less than adhesion and the mass breaks cleanly without any signs of ductility. Case (2) is the most suitable for cable compounds. C. C.

891. Examination of Bitumen Emulsions. T. Temme. *Asphalt u. Teer*, 1933, **33**, 457–462, 477–482.—A summary is first given of the specifications existing in America, England, France, Germany, Holland, Italy and Switzerland, followed by an epitome of recently published contributions to this subject. The questions to which attention is drawn include sampling ; bitumen, water and emulsifier contents ; the quality of the recovered bitumen ; the stability of the emulsion ; its behaviour on the road ; the viscosity ; the dispersion ; and the resistance to low temperatures. Some countries do not include certain of these tests in their specifications.

In general, bitumen content is determined by difference from water and ash contents. Water is estimated by evaporation, distillation or the Xylol Method. Recently *Abson and Heine* (Roads and Streets, 1932, 456) have slightly modified the A.S.T.M. method to obviate the foaming difficulty, while Keppeler and Dohse (*cf.* Abstr. 147) add strong electrolyte both in the straight distillation and in the Xylol Method. *McKesson* (Canadian Eng. 18/8/31) describes a rapid method, evaporating a small amount of emulsion on a thin plate. Usually the water content must not exceed 50%, but in Holland, unstable emulsions are specified to contain 32–42%. The Marcusson method determines the bitumen directly by precipitation with alcohol. The latter method is also specified for emulsifier content in some cases, while in England a guaranteed figure is required when exceeding 2%. This method is the most satisfactory when examination of the recovered bitumen is required. In Holland, acetone is used with the possible addition of a little ammonia. No general specification exists for the recovered bitumen, but in Holland the softening point (B. & R.) must not be less than 40°C.

The usual procedure for stability of emulsions consists in settling (noting any aqueous layer) and sieving to obtain coagulated bitumen. The time for settling varies from 3 days to 8 weeks. *Ohse* (in "Wie prüft man Strassenbaustoffe ?") gives a simple qualitative test in which a glass rod is dipped into the well-stirred emulsion. The latter should run off smoothly without lumps, etc. *Kirschbraun* (Roads and Streets 1933, 4.) describes the American Settlement Test, in which the top and bottom 50 ml. of 500 ml. standing in a cylinder for 5 or 10 days are examined for bitumen content. The difference must not exceed 3 or 6% respectively.

No tests are specified in England for the breaking of an Emulsion, but certain methods are described abroad. Essentially these consist in treating stone with emulsion, drying and noting any re-emulsification with water. In some cases the break-down time when the emulsion is mixed with sand or stone chips or (in Holland) portland cement, is noted. These methods depend on evaporation, whereas in Weber and Bechler's method (Abstr. 722, 1932) this doubtful factor is excluded. *Schulz* (Tag. Ber. der Petr. Ind.

28.5.32) indicates the requirements of the Czechoslovakian specification, and also critically examines the Czechoslovakian re-emulsification test in which coated stone chips are immersed in distilled water after three hours in air.

McKesson and others discuss the Myers demulsification test in which $CaCl_2$ solution is added to break the emulsion.

The continuity of the bitumen film is examined by *I. Vandone* (Annali dei Lavori Pubblici, 1932 (5), by dipping a coated limestone plate in dilute acid. Gas bubbles are developed where the film is incomplete.

Finally the resistance to low temperatures is discussed. Temperatures vary from –3 to –8°C. In some cases cooling and melting are repeated 5 times. In general, the homogenity must be restored on thawing. C. C.

892. Rapid and Accurate Analysis of Bituminous Materials. D. M. Wilson, *J.C.S.I.*, 1933, **52**, 579-581.—A modification of the method for analysing bituminous materials (*J.S.C.I.*, 1931, **50**, 599-600), which permits of the rapid examination of daily plant samples is described. The apparatus consists of a Kieselguhr filter cylinder of the Berkefeld type, which may be connected to vacuum or compressed air. The sample is dried at 110° C. and a representative quantity weighed while hot into a tared aluminium or stainless steel beaker. A filter cylinder of requisite size, placed in a glass beaker, is weighed. The beaker is then placed on a heating panel and the filter connected to a vacuum of 25-28 in. mercury. The bitumen is completely extracted with hot perchlorethylene, the extracts being placed in the filter beaker and drawn through the filter. When the liquid in the filter beaker has fallen to a low level, the filter is washed with hot solvent and compressed air is blown through the cylinder. Any liquid in the beaker or cylinder is then drained out by suction and the whole is dried at 150° C. while air is drawn through the cylinder.

The aluminium beaker containing mineral aggregate is also dried. The bitumen content is determined from the loss of weight of the sample. Fine material in asphaltic mixtures is retained completely, no ash is found on evaporating the filtrate and burning off the residue. Trichlorethylene may be used, but perchlorethylene is preferable on account of its higher boiling point and consequent lower loss. A solvent recovery plant employing activated carbon is interposed between the vacuum line and vacuum pump. A. O.

893. Breakdown Value of Bituminous Road Emulsions. H. Weber. *Asphalt u. Teer*, 1933, **33**, 520-525.—The author replies to Kell's criticisms of his original paper on this subject (*cf.* Abstr. 254). There is an optimum breakdown value for any given emulsion/stone system. Washing with soap solution and extracting the precipitated bitumen from the stone with benzole are unnecessary complications. Weber states that the washings are always passed through a fine mesh sieve which retains coagulated bitumen and fine particles of stone which may be suspended in the water washings. It is emphasised that the method is to serve for a practical evaluation of emulsions and does not purport to be an exact analytical method. The suggestion that breakdown may chiefly be caused by the soluble portion of the stone has not been satisfactorily confirmed.

The general conclusion is that modification of the method is unnecessary. The discussion is closed by further communications from Kell and Weber.
C. C.

894. "Sooting" of Bitumen. A. W. Rick. *Asphalt u. Teer*, 1933, **33**, 517–518.—Bituminous protective coatings, especially those from petroleum bitumen, are liable to show, under the action of atmospheric change, the phenomenon known as "sooting." ("Russen.") This shows itself by the formation of a dull surface layer, which is easily rubbed off as a dark powder, leaving relatively bright brown markings on the bitumen mass.

The author discusses the causes of this change and suggests three possible causes :—

1. Polymerisation by light. Certain asphalts, *e.g.*, Syrian, are particularly sensitive to light, but exposure of asphalt surfaces to ultra-violet light generally produced little change, and "sooting" could not be induced by this means.

2. Loss of oily material from the bitumen. This is not probable, as the hard brittle asphalts generally tend to show the effect less than the softer kinds.

3. Attachment of foreign dust to the surface. A microscopic examination reveals irregular particles insoluble in all solvents. These cannot be formed by the polymerisation of bitumen.

The author's suggested explanation is that heat rays warm the asphalt surface, making it slightly sticky and aiding the embedding of the dust particles. All the appearances of "sooting" can be explained by the deposition of dust; there is no real alteration of the asphalt and the influence of the atmosphere is slight. E. B. E.

895. Influence of Paraffin Content on the Properties of Road Asphalt. J. Muller and D. Wandycz. *Asphalt u. Teer*, 1933, **33**, 421–424.—Experiments were carried out in three ways: (1) Noting the change in properties on removing paraffin, (2) determining the effect of adding paraffin, (3) studying the influence of the method of manufacture.

The method of removing paraffin is that adopted by the authors for its determination (*Asphalt u. Teer*, 1932, **32**, 708). Essentially it consists in precipitating asphaltenes with 30–40° benzine. Most of the paraffin goes into solution (with the oily material), but remaining traces are removed from the precipitate by alcohol treatment. The wax fractions are dissolved in pyridine from which the paraffin is obtained by cooling to 0°C. The asphaltenes are dissolved in the residual pyridene, and the latter is then removed by evaporation—first in vacuo and then with a stream of CO_2.

A table shows the ductility and softening point of various samples before and after treatment. Actually, removal of paraffin lowered the ductility of hard asphalt and raised that of soft asphalt. To some degree, the influence of paraffin depends on the proportion of oil present. The softening point of a hard asphalt may be raised on removing paraffin, while that of a soft asphalt may be lowered.

In the second series of experiments, mixtures were prepared of road asphalt (5·25% paraffin) with commercial wax, crude ozokerite and paraffin obtained from asphalt. The latter mixture is, of course, the most important, and, while an addition of 4% or 6% had but little effect, 8% showed a definite diminution in ductility in the example given, but addition to a harder asphalt may improve the ductility. It is concluded that the paraffin content is not necessarily the decisive factor in adversely affecting the properties of asphalt; the chemical composition of the bitumen plays a much more important part. It was found that the properties depend

largely on the method of manufacture of the bitumen. Generally, the constituents of paraffinic crudes appear to be more readily decomposed and more easily polymerised than other crude oils, and the substances formed may affect the asphalt adversely. Nevertheless, by suitable methods, it would appear to be possible to prepare asphalt of satisfactory properties from an oil of the paraffinic type. C. C.

896. Separation of Free Carbon from Mineral Matter in Examination of Tar Mixtures. E. Ohse. *Asphalt u. Teer.*, 1933, **33**, 441–443.—When tar is extracted from a mixture, using any of the usual solvents, the insoluble matter—free carbon—remains on the stone. This loss of free carbon affects both the amount and properties of the recovered tar. If the free carbon can be estimated, a better comparison can be made between the properties of the recovered and the original tar.

Ohse's process for estimation of free carbon depends on forming a suspension of the material by washing the stone with dilute soap-solution after extraction of the tar. The solvent is completely removed and the residue weighed. It is boiled for half an hour with a 3–5% solution of potash soap. The mass is then decanted through a sieve (900 mesh to the sq. cm.) and the residue washed till free from alkali and dried at 110° C. The difference in weight before and after the soap-washing gives the weight of free carbon, which should be added to the solvent extract to give the weight of tar.

The process has advantages over the roasting process, in that no decomposition of the stone (*e.g.*, loss of carbon dioxide) occurs. E. B. E.

897. Exhaust Gas Analysis. C. C. Minter. *Nat. Petr. News*, 28.6.33, **25** (26), 33–38.—It is possible to determine the carbon content of a volatile hydrocarbon from an examination of the exhaust gases from a single cylinder internal-combustion engine. The method of evaluation is based on the fact that the thermal conductivity of the exhaust gas decreases linearly when fuel is in excess and increases linearly when air is in excess, a minimum occurring at an air/fuel ratio near to that giving complete combustion. The apparatus consists of two thermal conductivity cells A and B and two resistances connected as a Wheatstone's bridge. The exhaust gases are drawn through dilute H_2SO_4 and passed through an Orsatt apparatus and cell A which are connected in parallel. Cell B contains air. The CO_2 content and the thermal conductivity of the gas in relation to that of air can, therefore, be estimated for any particular carburettor setting. Then if E.M.F. be plotted against CO_2 content for a number of fuels of different carbon content it is found that the curves have a common point. Therefore, in practice this common point may be fixed arbitrarily and since the function is linear a single determination on a fuel determines the angle of slope of the curve. Further, since the slope of the curve increases linearly with carbon content one other determination with a fuel of known carbon content leads to that of the unknown fuel. Alternatively the carburettor may be set to give an exhaust containing an arbitrarily fixed CO_2 content when the thermal conductivity will be found to vary as the carbon content of the fuel. Then if part of the exhaust gas is freed from CO_2 by passing it through soda-lime and the "bridge" is balanced a redetermination made of the thermal conductivity of the straight exhaust gas will give another reading different from the first. The magnitude of this difference will vary according to the carbon content of the fuel as indicated above. Hence it is now possible to calibrate the millivoltmeter scale to read carbon contents directly. H. G.

Class 600. Refining and Refineries.

898. Fractional Distillation. R. McIntyre. *J.S.C.I.*, 1933, **52**, 578–579.—The author briefly considers the disadvantages of certain well-known types of laboratory fractionating equipment, and stresses the importance of using a well-lagged column fitted with some type of dephlegmator. This is preferably of the total condenser type in which some desired fraction of the condensate may be returned as reflux to the column head. Such a piece of apparatus is described which may be fitted conveniently to the usual types of column. W. E. J. B.

899. Design of Fractionating Columns. A. J. V. Underwood. *J.S.C.I.*, 1933, **52**, 223T–227T.—This paper is mainly mathematical, and describes two methods for calculating the number of theoretical plates required for a given separation, without finding the composition of the liquid on every plate.

The first method utilises the conception of an average "enrichment factor," while the second also makes use of the "key" components, and obviates the necessity of taking into account all the components of the mixture.

The methods are illustrated by the consideration of a fractionation of a mixture of hexane, heptane, octane, nonane and decane. W. E. J. B.

900. Prevention of Fog Entrainment in Continuous Distillation. A. E. Birch and H. M. Weir. *Chem. Met. Eng.*, 1933, **40**, 366–368.—Determination of the contamination of overhead streams by asphalt in the continuous distillation of crude in pipe stills has shown that the instillation of some device to remove asphaltic fog will effect important economies in the subsequent refining of these overhead products. After a number of trials a suitably modified Centrifix separator was found to work satisfactorily. It was inserted in the vapour line of an atmospheric pipe still just before the fractionating column. All the pipe-still charge passes through the Centrifix, which separates liquid from vapour by centrifugal force generated by high-speed vapours. There are no moving parts in the separator, a rapid rotation being imparted to the vapour liquid stream by a pair of fan-like elements with stationary blades. The pressure differential from inlet to outlet of the separator is of the order of 0·5–1 lb./sq. in., so that the power cost of the device is negligible. After 1119 hours of continuous operation in a crude oil distillation plant the separator showed practically no sign of wear. Considerable saving in refining costs have been effected by use of the Centrifix when high viscosity lubricating oils were taken overhead. The amount of acid used in the finishing treatment was more than halved and the yield of refined oil was correspondingly greater. The oil had also a better appearance. Photographs and diagrams of the Centrifix separator are given.
G. R. N.

901. Overall Comparison of Various Methods of Refinery Fractionation. T. B. Leech. *Petr. Eng.*, June, 1933, **4** (10), 13.—The economics of fractionation and vaporisation by various systems are discussed in the light of the experience of refiners on the following points: (1) That for any given temperature single-flash vaporisation of petroleum is more economical than multiple-flash vaporisation in heat requirements, the quantity of available vapour is larger, the quantity of residuum smaller and the overlap between the two less; (2) that if extremely good fractionation is required between light hydrocarbons, not more than two streams (top and bottom) should be taken from any one tower. The methods of operation and the efficiency and economic functioning of the four following existing types of fractionating

equipment are discussed: No. 1. Multiple-flash equipment consisting of 4 towers in series each intake being heated in a separate pipe still or in different coils in the same pipe still. Reflux is supplied to the top of each tower. No. 2. Single-flash primary tower, the overhead being led successively through three further towers where lighter cuts are taken off in turn. Reboilers are provided with each tower for stripping purposes, while the reflux is pumped back over the previous tower. No. 3. Single-flash unit with single stripping tower, light gasoline being taken from the top, stripped fuel from the bottom and the side cuts taken from the main tower to their respective strippers, stripped with steam and cooled. Each side cut is controlled by reflux pumped back from the side stripper. No. 4. System differs from No. 3 in that individual reflux from the stripper for each side cut is not provided, control being effected by the tray conditions within the tower, only overhead reflux being used.

The comparative advantages of the various units are as follows:—

No. 1 Unit gives the greatest flexibility and allows towers of smaller diameter to be used. Crude oils can be heated to the exact temperature required for each tower, and reflux pumped back to the top of each tower in equilibrium with the product being withdrawn from that tower and in the required quantity. No outside stripper is required, stripping sections being provided in each tower.

The disadvantages are that multiple-flash evaporation is extremely inefficient in the use of heat, while four sets of heating, pumping and condensing equipment are necessary. The total height of towers is almost double that required for a single-flash tower provided with side stripper.

No. 2 Unit is extremely flexible, and the single-flash vaporisation is much more efficient, but requires towers of larger diameter than No. 1 as the reflux provided in No. 4 tower provides reflux from a heat standpoint for all previous towers. Also, the stripped material returned to each preceding tower as reflux is heavier than the material coming overhead and throws the system out of equilibrium. This necessitates slight additional stripping and also adversely affects reflux conditions. This system also has the disadvantages of No. 1 in the additional equipment required.

No. 3 Unit. Besides having single-flash vaporisation, a much greater heat head is available for exchangers than is available from a reflux vapour heat exchanger or vapour heat exchanger alone. The sections of the tower can be successively decreased in diameter, while control of an individual cut independent of the operation of the remainder of the tower is within certain limits possible. There are, however, many disadvantages. The introduction of reflux for each side stream requires additional equipment and upsets tower equilibrium and withdraws more light fractions than a side-drawn product, while offsetting the tower requires special structural arrangements. Individual control of side streams may possibly upset tower equilibrium, while the break in the size of the tower limits the flexibility as far as regards variation in boiling range of the cut required. To overcome this additional pans would have to be fitted to the main tower.

This system is only desirable where the high cost of fuel makes heat exchange more attractive than the cost and difficulty of 4 point control and operation.

No. 4 Unit has the advantages of single-flash vaporisation, and allows close cuts to be withdrawn without disturbing equilibrium conditions. Only single condenser, reflux and control equipment is required, so that operation is much simpler than in the case of the No. 3 Unit. As only a fraction of the material is withdrawn to the side stripper, as compared with No. 3, this can be smaller in diameter, while, as the material withdrawn is at its own equilibrium conditions, little additional heat or steam is required for control.

The high heat head of each of the side streams can be effectively used for heat exchange.

The main disadvantage is that as reflux is not introduced for each of the side streams, only the amount of the side stream is available at a higher heat head than the overhead material for use in exchangers.

It is concluded that No. 4 type is superior to the other three types as far as regards initial expense, maintenance cost, operation of accessories and general fractionation. C. L. G

902. Operation of the Stratford Oil Circulation System in Rumania. S. Dobrescu. *Refiner*, 1933, **12**, 266–272.—The operation of a unit rated at 4500 brl. of the Dacio Romano Petroleum Synd., charging either Piscuri Drader non-paraffinous or Meotic Paraffinous crude and incorporating Stratford oil circulation heaters is described.

These heaters are each composed of a radiant section, tubular convection or economiser section and a corrugated envelope type air preheater. In the radiant section, a corrugated firing tube 4 feet in diameter by 12 feet overall length provides approximately 120 sq. ft. of radiant heating surface. Around the exterior of the corrugated tube and close to it is a second tube not corrugated, into which are fixed the oil circulation nozzles. A third or outer shell provides a means of distributing circulation oil under pressure to the oil circulation nozzles. The oil passes through the nozzles, which are sufficient in number for the impinging jets to completely cover the corrugated heating surface, at a velocity of 25/30 metres per sec. and after discharge against the heating surface flows between it and the tube retaining the nozzles to the oil exit. The film temperature is maintained within a few degrees of the temperature of the main body of treated oil and by reason of the high-velocity film the heated surface remains free of deposits.

The convection sections are of tubular design with stream line return bends and each contains 94 sq. ft. of internal heating surface. Heating is by Peabody mechanical atomising burners.

Processing to a capacity of 5700 brls. per day, vaporising approximately 50%—the heat transfer rate of this radiant section is about 60,000 B.Th.U. per sq. ft. per hour. The fuel release is approximately 69,000 B.Th.U. per hr. per cu. ft. of furnace volume, and the heat efficiency of the heater is approximately 88%, 70% of the total fuel heat being utilised through the radiant oil circulation heaters.

These heating units differ from those previously installed elsewhere in that the earlier stills held a large bulk supply of oil and the firing tube was a flat cylinder while the newer still employs a corrugated fire tube and the annular space between the tube and the outer shell is as small as is mechanically possible, circulation being effected with the bottom of the tower acting as bulk supply. B. C. A.

903. Vapour-Phase Cracking. H. P. A. Groll. *Ind. Eng. Chem.*, 1933, **25**, 784.—The pyrogenetic conversion of gaseous and liquid hydrocarbons into aromatics has been investigated and vapour-phase cracking of gas oil studied at atmospheric pressure over a wide range of temperatures and rates of throughput. Of all gaseous hydrocarbons, propylene gives the highest yields of aromatics. Striking regularities are found in the pyrolysis of all hydrocarbons. These are believed to contribute essential data to the theory of cracking, especially with respect to the formation of aromatic hydrocarbons at temperatures of about 800° C, the mechanism of which appears to be much simpler than for low-temperature cracking. At all temperatures, " demethanisation " is found to prevail over dehydrogenation, provided carbon formation is prevented. The nature and yield of products are functions of temperature

and rate of throughput and these two variables are found to be connected by a simple function over a comparatively wide range. A method is given by which the throughput of commercial vapour-phase cracking processes can be increased considerably. W. H. T.

904. Catalytic Reduction of Carbon Dioxide with Hydrogen. H. Koch and H. Küster. *Brenn.-Chem.*, 1933, **14**, 245–51.—The catalysts using nickel and cobalt developed by Fischer and Tropsch for benzine synthesis have been found valuable for the catalytic reduction of carbon dioxide by hydrogen. The reaction using these catalysts can be carried out at 150° C. The principal reaction product was methane. Only in individual cases could carbon monoxide and oxygen containing compounds be detected in small quantity. By the employment of a large excess of carbon dioxide a complete equilibrium was obtained, which, under the range of temperature 150°–400° investigated, lies almost completely on the side of methane. The addition of water vapour to the gas charged substantially reduces the hydrogen exchange. By the double decomposition of furnace gas with hydrogen a mixture of carbon dioxide and hydrogen diluted with nitrogen was obtained, which in a further reaction step was led over a cobalt catalyst with methane formation. The use of a nickel catalyst also resulted in a quantitative exchange. Methanol a possible intermediate reaction product of the carbon dioxide reduction is completely decomposed at a temperature of 200° C. in the presence of carbon dioxide and a nickel catalyst. The catalysts employed are subject to poisoning by sulphur compounds. B. C. A.

905. Slow Oxidation of Aromatic Hydrocarbons at High Pressures. D. M. Newitt and P. Szegö. *J.S.C.I.*, 1933, **52**, 645.—The results obtained by high pressure oxidation of the paraffin hydrocarbons can be explained on the supposition that the hydrocarbon molecule undergoes hydroxylation. The liquid- and vapour-phase oxidation of toluene at ordinary pressures has, however, indicated that the benzene nucleus does not undergo direct hydroxylation. The authors have succeeded in performing smooth oxidations of toluene by means of air at 210° C. and at pressures of 50 atmospheres, in which about 60% of the toluene oxidised, appeared as hydroxylated compounds. The products consisted mainly of benzyl alcohol with small quantities of benzaldehyde, benzoic acid and 2, 4 dihydroxy toluene. The occurrence of benzyl alcohol together with the dihydroxy toluene indicates simultaneous oxidation, via hydroxylation, of the aromatic nucleus and aliphatic side chain.

Benzyl alcohol is apparently only obtained with high-pressure experiments as the atmospheric oxidation of toluene gives benzaldehyde, benzoic acid and anthraquinone. W. E. J. B.

906. Control of Filter Cakes in Contact Treating. L. C. Trescott. *Refiner*, 1933, **12**, 263–265.—Whilst the use of a clay is normally determined by its decolourising properties, without regard to the filter flow obtained, by attention to the factors governing the latter, an improvement in filter rate may frequently be effected.

Acid-treated and high-powdered clays usually give a good flow rate, those of German origin being usually more porous than equivalent American clays. Natural clays showing a slight alkalinity are apt to form a plastic filter cake which quickly plugs the filter. Cracking of the cake when formed as on a continuous rotary vacuum filter, and permitting the passage of air leads to oxidation and inefficient decolourisation, is also a function of the clay.

A second factor influencing flow rate and cake formation is the oil under treatment, untreated oils leading to little difficulty. Acid-treated sour oil

is usually free filtering, unless an undue quantity of pepper tar be present, when the addition of from 1–5% of water will serve for its flocculation, usually although not always without effect on the decolourising value of the clay.

An increase in filtration temperature say from 175° to 275° F. has been observed to yield an improvement in flow beyond that assignable to viscosity decrement. Oils previously washed with alkali are productive of filter cake troubles, due to the presence of free alkali or soaps. The former will displace colouring matter from the clay and also tends to cause a tight plastic cake. Sometimes the addition of a small quantity of acid will rectify the deficiency. In general alkalinity in a filter cake and therefore the addition of alkalies should be avoided.

Moisture is a common cause of bad filter cakes and where water is evolved in the clay contacting, it should be vented from the system. B. C. A.

907. Removal of Hydrogen Sulphide from High Sulphuric Gases. P. J. Wilson, Jr. *Refiner*, 1933, **12**, 256–262.—The concentration of H_2S in gas may amount to as much as 10 or 20% by volume. The low sulphur gases containing up to 500 grains per 100 cu. ft. can usually be successfully treated by the methods employed for manufactured gas, such as the Seaboard process, employing scrubbing with a solution of soda ash followed by regeneration by air blowing or by the Ferric oxide process.

For the economic handling of higher concentrations other absorbents have to be employed, the operation being in general effected by scrubbing the gas in an absorbent tower with a solution or suspension of the reagent. The fouled reagent is regenerated by steam blowing.

The reagents employed may be divided into two groups, viz., the weaker bases such as ammonium magnesium hydroxides, triethanolamine, and the alkaline salts formed by a combination of a strong base with a weak acid. The former combine directly with hydrogen sulphide to form sulphides or hydrosulphides, all of which sulphides are readily decomposed on boiling with regeneration of the original solution and evolution of the hydrogen sulphide. To this class belong ammonia, magnesia, lime in salt solution, and triethanolamine. Of the salts of strong bases only sodium carbonate or sulphide have been employed.

An editorial note draws attention to a process employing a solution of sodium phenolate, made from caustic soda and tar acids. B. C. A.

908. Recovering Benzole with Activated Charcoal. A. Engelhardt and H. Rüping. *Gas J.*, 1933, **203**, 154; *Das Gas u. Wasserfach*, 1933, **76**, 478–484.—This article gives a comparison of the wash oil and activated charcoal processes of benzole recovery.

In the case of a gas containing initially 1·06 gms. of benzole per cubic foot, the wash-oil process reduced the benzole content to 0·377 gm. per cu. ft., whereas the charcoal process gave a gas of 0·003 gm. per cu. ft. benzole content. The former process is thus only about 65% as efficient as the latter. In addition, it was found that the benzole recovered by means of the charcoal process contained no corrosive sulphur, whereas with the wash-oil process, the benzole contained 6–10 mgm. per litre of corrosive sulphur. The former process, moreover, gives a benzole with a very low phenol content and a lower content of pyridine bases. The inhibitor process is therefore applicable with greater simplicity. It is also found that the gum content of the stabilised, charcoal process, benzole is lower. W. E. J. B.

909. Natural Gas and Natural Gasoline. T. Hoffman. *J. Inst. Petr. Techs.*, 1933, **19**, 549–553.—A review of activities during 1930–31 in the fields of natural gas and natural gasoline which discusses pipe lines, odorisation, liquefied petroleum gases, chemical products and conservation. G. R. N.

910. Recent Developments in Carbon Black Production. L. Light. *Paint Manufacture*, 1933, **3**, 201–204.—The author reviews briefly the recent work on carbon black formation, where the starting point is a liquid or gaseous hydrocarbon or carbon monoxide. Recent patents are quoted in describing the plant required to produce carbon black from anthracene residues, etc., and the method of Hardy (E.P. 356,236) for utilising grades of anthracite or lignite is described. Recently it is claimed that difficulties attendant upon the production of black from carbon monoxide have been overcome (G.P. 565,053 and 551,534). Finally two recent processes exploiting the value of the extremely high temperatures of the electric arc are described (E.P. 345,237 and 371,916), whilst a process using chlorine is also mentioned (G.P. 552,466). W. E. J. B.

911. Inhibitors in Cracked Gasoline. II. Correlation of Inhibiting Action and Oxidation-Reduction Potential. C. D. Lowry, G. Egloff, J. C. Morrell and C. G. Dryer. *Ind. Eng. Chem.*, 1933, **25**, 804.—A correlation has been established between the effectiveness of gasoline inhibitors as measured by an accelerated oxidation test and their critical oxidation potentials. The best inhibitors were found to have potentials between 0·6 and 0·8 volts, fair inhibitors having a range of 0·8 to 1·043 volts. Compounds with potentials above the latter figure have practically no inhibiting action under the conditions of test. Hydroquinone and certain others show less inhibiting action in the bomb test than their potentials would indicate, this being attributed to their tendency to undergo direct oxidation. W. H. T.

912. Treating Natural Gasoline with Various Types of Hypochlorite Solutions. Anon. *Refiner*, 1933, **12**, 278–280.—It is estimated that three-fourths of the natural gasoline manufactured is treated with some form of chlorine solution.

The application of chlorine, either in conjunction with caustic soda or as bleaching powder or calcium hypochlorite, is described. B. C. A.

913. Motor Spirits and Light Distillates. D. A. Howes. *J. Inst. Petr. Techn.*, 1933, **19**, 557–566.—A review of motor fuels during 1931 which discusses the properties of gasolines, anti-knock values, anti-knock materials, motor fuel compositions, gum problems, and colouration of gasoline. G. R. N.

914. Manufacture of Bright Stock—Present and Future. P. M. Robinson. *Refiner*, 1933, **12**, 273–277.—The unvaporized residue from the primary distillation of Pennsylvania Crude is known as steam-refined stock. It is filtered through fuller's-earth to remove colour. The filtered oil is dewaxed, either by cold settling or centrifuge, re-run to remove diluent and to bring to viscosity and flash specification. It is finally refiltered. Pennsylvania Crude yields about 15% Bright Stock.

From Pennsylvania Crude high viscosity index products are obtained at no extra cost. It is suggested that the conception of lubricating oils consisting of diluent and lubricant is particularly relevant to the case of bright stock, and that the lubricant is represented by polar compounds, which are the heaviest molecular weight constituents of the oil.

It is important that the refining processes do not injure these components. In the primary distillation process care should be taken not to heat the oil

above the cracking temperature of these products. Filtration must be regulated so that although oxidized and polymerised products are adsorbed, high molecular weight polar compounds are not removed.

Centrifugal dewaxing is regarded as the poorest link in the productive chain, as about 15% of product is discarded to remove 4–5% wax. Paraflow is effective in reducing pour test provided that a sufficiently large percentage of neutrals is present. For heavier oils such as aircraft oils, paraflow has no effect.

The polar compounds represent the true value of Pennsylvania oils for lubrication and the attainment of high viscosity index is not in itself sufficient as the products of high viscosity index serve as a carrier to the lubricating products. B. C. A.

915. Lubricants and Lubrication. A. R. Bowen. *J. Inst. Petr. Techn.*, 1933, **19**, 578–591.—A review of the progress during the year in the refining of lubricating oils, in the theoretical conceptions of lubrication and in the application of lubrication principles in machine design. G. R. N.

916. Synthetic Lub. Oils from Gaseous Olefines. A. D. Petrov, L. I. Antzuz and E. N. Pozhiltzeva. *Refiner*, 1933, **12**, 293–296.—The paper covers the catalytic conversion of olefines in the presence of $AlCl_3$ to synthetic lub. oils. An ethylene concentrate was used, containing 20–33% olefines, the remainder being principally methane and hydrogen. The catalyst, as fine powder was charged to an autoclave with an equal amount of petroleum ether (45°–70° C.) and the concentrate was transferred from a bomb under a pressure of 40–60 atmos. After the autoclave pressure dropped to 30 atmos. time varying according to the experimental conditions, temperature, autoclave capacity, etc., the remaining gas was discharged and additional concentrate injected. The experiments were carried out in a rotating Bergius autoclave placed in a shaking machine and in 2–3 litre stationary autoclaves, and at room temperature and 100° C.

Two oils were produced in these experiments, viz., the free oil dissolved in the solvent and recovered by distillation and oil in combination with the catalyst and which was recovered by the addition of water to the autoclave residue after removal of the free oil solution. In the experiments at room temperature the free oil contained 2% and the combined oil 20% of hexaethyl benzene (m.p. 129° C.). At 100° C. this hydrocarbon was obtained only in small quantities of less than 0·1%. The oils obtained are comparable with synthetic oils prepared by Otto using boron trifluoride and with American oils. The higher temperature favours the production of compounds soluble in sulphuric acid and of higher viscosity and sp. gr. for a given boiling range, and hence of a steep viscosity temperature curve. B. C. A.

917. Manufacture of Asphalt from Acid Sludge. F. W. Padgett, J. W. Donnell and R. I. Jacobi. *Petr. Eng.*, June, 1933, **4** (10), 18.—The results of laboratory work on the preparation of asphalt from acid sludge by treating residual oils from Oklahoma City crude is described, and the characteristics of the sludge and of the asphalt discussed. It was found that 94/97% of the sulphuric acid used could be recovered, and that asphalt of varying hardness, good ductility and composed almost entirely of bitumen, could be obtained. The oil was treated with acid for about 20 mins. at 125/132° F. and the sludge settled and removed.

The fresh sludge was fluxed with 1–5% of gas oil and agitated so as to form an emulsion which was broken by heat or chemicals—cresol being found the most effective. The tarry matter was separated and neutralised with lime, calcium sulphate separating out, and a vacuum distillation of the

tar carried out. A representative asphalt obtained had the following properties: sp. gr. at 60° F. 1·09, Pen. at 77° F. 90, soft pt. 152° F. Flash 435° F. % sol. in CS_2 96%, % sol. in 88 naphtha 82%, asphaltous acid anhydrides 1·4%, asphaltenes 26·6%, oily constitutents 50·10%. The ductility was well over 100, probably due to the high percentage of asphaltic resins. Accelerated weathering tests gave results similar to those obtained on commercial asphalts.

The work carried out indicates that the action of acid on uncracked residual oils is one of solution and precipitation, practically no reaction products being formed. Asphaltic matter is generally considered as being in colloidal solution in the oil, but its chemical nature is not agreed upon. It has been suggested that it consists of colloidal carbon or again of organic oxygen and sulphur compounds or hydrocarbons of high molecular weight, the protective colloids being oils of high molecular weight or readily absorbable resins. It is reasonable to expect that organic oxygen and sulphur compounds might be slightly soluble in acid whereas colloidal carbon would be precipitated. Dilute acid, however, does not precipitate asphaltic matter from petroleum, so that it is reasonable to conclude that the solvent effect is more important than the precipitating effect.

Work on the hardening of sludge indicates that the coke-like substance formed is not carbon, but either (*a*) gel type of dispersion arising from the emulsion type of colloid, or (*b*) compounds of high molecular weight resembling carbon or coke caused by polymerisation or condensation of the organic sulphur and oxygen compounds.

The asphaltic matter recovered from acid sludges differ from the true asphaltenes as in the latter case the naphtha dissolves the protective colloids to a greater extent than does acid. Asphalt from sludge is more readily soluble in petroleum oil than asphaltenes.

Microphotographs showing the fresh emulsion, the breaking effect with cresol and the coking at start and finish are reproduced and it is concluded that the disperse phase of the emulsion consists of dilute acid, the continuous phase being oil with a protective colloid of resinous asphaltic material. Abstracts of various articles dealing with the composition of asphalt and the manufacture of asphalt from acid sludge are given, together with a partial list of patents on the preparation of asphalt from acid sludge. C. L. G.

918. Asphalts and Road Materials. W. W. Goulston. *J. Inst. Petr. Techn.*, 1933, **19**, 617–627.—A review of the literature published during the year on: (i) rock asphalt, natural asphalt and petroleum bitumen; (ii) the application of these materials; (iii) asphalt emulsions, and (iv) specifications and testing. G. R. N.

919. Gas, Oil, Diesel Fuel Oil and Fuel Oil. F. H. Garner. *J. Inst. Petr. Techn.*, 1933, **19**, 592–599.—A brief account of: (i) the examination of gas oil with regard to its commercial uses; (ii) the examination of Diesel fuel oil with regard to its behaviour in various engines, its ignition quality and its laboratory evaluation, and (iii) the uses of fuel oil during the year under review. G. R. N.

920. Kerosine and White Spirit. S. T. Minchin. *J. Inst. Petr. Techn.*, 1933, **19**, 574–577.—Published literature on: (i) the refining of kerosine; (ii) the burning properties of kerosine and their relationship to the method of refining, and (iii) white spirit during the year is shortly discussed. G. R. N.

921. Special Products. E. B. Evans. *J. Inst. Petr. Techn.*, 1933, **19**, 628–635.—Investigations on naphthenic acids, the use of butane, etc., acid sludge, petroleum coke, carbon black, hydrocarbon solvents, insecticides, paraffin wax, synthetic chemicals from petroleum and transformer oils are briefly described. G. R. N.

922. New Inorganic Heat Carrier for High Temperatures. T. Kayser. *Chem. Met. Eng.*, 1933, **40**, 353–354.—An ideal heat carrier should be a substance which can be manufactured at a reasonable cost and present the highest possible heat capacity. Working temperatures up to possibly 1600°–1800° F. should be obtainable without decomposition. It should not corrode ordinary metals and should be as fluid as water within the widest range of temperature. Recently there has been compounded a fluid known as NS fluid, which approaches this ideal. It is a mixture of the chlorides of sodium, aluminium and iron (ferric). It has a specific heat of 0·7 and a specific weight of 1·96–2·00. The heat conducting capacity of the fluid is so favourable that there is little tendency to the formation of crystals at the heat transfer surface. Its heating-cooling curve shows that it has a softening range that can be regulated as desired below the melting point, 302° F. Its expansion in the liquid state at medium temperatures is about 10%. When used in a closed system the fluid does not decompose. From tests the calculated overall heat transfer coefficient was 23·6 B.Th.U./sq. ft./deg. F./hr. from NS fluid to water through iron. Within the temperature range from 302° to 1508° F. the fluid was a thin liquid somewhat like water. NS fluid was tested in an oil distillation plant at 1500° F. over a period of 9 months. It was shown that for a temperature drop of 1472° to 572° F. the available heat from 1 cu. ft. of flue gases was about 1·15 B.Th. U., the available heat from 1 cu. ft. of NS fluid was about 70,000 B.Th.U. In view of the considerable amount of heat energy that this fluid can store, it is considered that its use in distillation and cracking plants will mean the employment of considerably lower temperatures. G. R. N.

923. Specification for Chrome Tungsten Steel Castings. B. B. Westcott, V. T. Malcolm and H. Henderson. *Refiner*, 1933, **12**, 281–292.—The formulation and adoption of standard specifications for the newer alloy steels has lagged behind practical application, and the paper details the development and justification for a specification referring to chrome tungsten steel castings, which is reproduced in full as adopted by the Gulf Refining Company.

The specification covers steel castings containing approximately 5% chromium and 1% tungsten, intended for use in petroleum refining operations under corrosive conditions at elevated temperatures and high pressures.

Following clauses referring to patent infringement and design and patterns, it is specified that the steel shall be made by the electric furnace process unless written authority be given to employ the open hearth process. Limiting percentages of components, together with the desired composition, are specified. Heat treatment to specified physical properties is required, but quenching in any liquid medium is disallowed. The static physical properties are determined using test specimens conforming to given dimensions and tested as prescribed. The minimum limits for the physical properties of test specimens prepared from castings weighing less than 150 lb., and of test bars in the cast of castings weighing more than 150 lb. are laid down.

Clauses referring to destructive impact test, sectional and macroetching tests, metallographic structure, hydrostatic tests, repairing of defects, radiographic inspection, workmanship and finish, marking, inspection and rejection, complete the specification. B. C. A.

824. Synthesis of Acetylene by Pyrolysis of Methane. H. H. Storch and P. L. Golden. *Ind. Eng. Chem.*, 1933, **25**, 768.—A product has been obtained, containing about 10% of unsaturated hydrocarbons (mainly acetylene), 10% CO, 35% H_2 and 45% CH_4, by passing a mixture of 75% CO_2 and 25% CH_4 through a tube at 1500° C. (contact time 0·03–0·04 sec.), and by subsequently scrubbing out the carbon dioxide. With longer contact times, the water gas content of the product increases at the expense of the methane, the percentage of unsaturated hydrocarbons remaining approximately constant. Steam is less desirable than CO_2 as a diluent because the loss of CH_4 as carbon deposited in the reaction tube is increased thereby from a trace to 15–20%. W. H. T.

925. Patents on Crude Oil. Lummus Co. E.P. 394,858, 6.7.33.—Petroleum bottoms are divided to obtain a high-grade asphalt residue and a lubricating oil as an overhead product by adding a diluent oil at least as volatile as gas oil and subjecting all of the oils to a continuous flash vapourisation without cracking. W. S. E. C.

926. Patents on Cracking.—W. M. Cross. U.S.P. 1,916,205, 4.7.33. Process and apparatus for producing synthetic crude by the cracking of heavy oil. The synthetic crude while still in a heated condition is passed to an evaporation stage at reduced pressure. The resultant vapours are fractionated and the reflux condensate recycled.

H. L. Doherty. U.S.P. 1,917,705, 11.7.33. Cracking oil by means of pre-heater and "soaking" vessel, and withdrawing residue from the latter intermittently and with a surging action. The latter is effected by sudden reduction of pressure.

C. Angell. U.S.P. Re. 18,899, 18.7.33. Crude is topped to give a motor fuel and a cracking stock which is converted to yield cracked gasoline, residue and an intermediate conversion product. The latter is cracked in a separate heating coil to which is simultaneously supplied the straight-run spirit from the crude.

E. Marshall. U.S.P. 1,918,278, 18.7.33. Conversion of heavy residues containing coke into a distillate and a solid residue free from liquid and volatile matter.

W. Sims. U.S.P. 1,918,670, 18.7.33. A method of increasing the yield of cracked gasoline by cracking, fractionating and cooling under a vacuum, and by suitably regulating temperatures and pressures in different parts of the system.

C. MacKay. U.S.P. 1,918,766, 18.7.33. In order to facilitate the removal of residue from cracking stills and to prevent plugging of the lines with coke, provision is made for circulating the residue at those points where expansion takes place.

H. Snow. U.S.P. 1,918,991, 18.7.33. Vapour-phase cracking, in which, in order to increase yields of gasoline, the vapours are maintained at 850°–975° C. and 100–400 lb. pressure for a sufficient time to secure a minimum proportion per pass of cracked product (2·5% at 100 lb. and 13% at 400 lb.).

J. C. Black. U.S.P. Re. 18,896, 18.7.33. By cracking at a temperature below that of "excessive carbonisation," it is claimed that carbenes instead of carbon are formed and may be kept in solution by pressure. The formation of gas oil is limited and the yield of gasoline increased. Fouling of the tubes is lessened by injection of oil to the final passes.

W. M. Cross. U.S.P. 1,919,320, 25.7.33. Cracking apparatus comprising, heating coil, cracking chamber, evaporator and dephlegmator successively

connected. A conduit connects the supply tank with the coil, a portion of the conduit being located within the dephlegmator.

H. Thomas, U.S.P. 1,919,672, 25.7.33. A process of quickly cooling cracking coils after shutting down for cleaning, repairs, etc. Water under pressure is passed through the heat exchangers, thence through the coil, the steam generated assisting the removal of oil, etc. from the coil.

E. Ewing. U.S.P. 1,919,691, 25.7.33. Apparatus for securing from cracked distillate, products of desired characteristics in a plurality of separate fractions. The plant comprises a series of rectifying columns each fitted with a reboiling zone. W. H. T.

927. Patents on Coal and Shale. British Coal Refining Processes, Ltd., and P. M. Salerni. E.P. 393,297, 18.7.33.—Solid, smokeless fuel of high calorific value is prepared by mixing with coal a proportion of finely divided semi-coke and submitting the mixture to a rumbling action in a rotary retort, for the production of fuel in ball form. W. S. E. C.

928. Patents on Hydrogenation. Somerset, Holroyd and I.C.I., Ltd. E.P. 392,559, 17.5.33.—This relates to the use of tin compounds, as catalysts for the hydrogenation in the liquid phase of mixtures of heavy oil with solid carbonaceous materials. The tin compounds preferred on the salts of organic acids, *e.g.*, stannous oxalate, etc., associated with those copper and/or iron compounds which decompose at reaction temperatures leaving the metal in a fine state of division. S. B.

I. G. Farbenind. A. G. E.P. 392,688, 25.5.33. Temperature regulation and control in exothermic hydrogenation reactions is effected by a regulated flow of water through tubes arranged either inside the reaction vessels or externally between the vessels when a number of these are connected in series. The water circulates at a pressure approximately equal to the reaction pressure, thus obviating the use of special pressure tubing. S. B.

Tide Water Oil Co. E.P. 395,345, 11.7.33. Production of oil gases of high calorific value for use in enriching blue water gas and aromatic hydrocarbons as a by-product by destructive hydrogenation of petroleum fractions. The latter are treated under a pressure of approximately 50 atmospheres and at a temperature of 530° C. with coke-oven gas for ½ hr. A catalyst can be used if desired.

E. D. Kamm and I. C. I. E.P. 395,370, 13.7.33. Preparation of hydrocarbons by the hydrogenation of phenol and its homologues in the vapour state with hydrogen under a pressure of 15 atmospheres and at a temperature of 350–500° C. Oxides of molybdenum, or ammonium molybdate or zinc and magnesium oxides in equimolecular proportions are utilised as catalysts, hydrogen being present in the reaction gases. W. S. E. C.

R. P. Russell. U.S.P. 1,916,441, 4.7.33. A mixture of heavy oil and gas rich in free hydrogen is passed through a heating zone into a body of the oil maintained at decomposition temperature and at above 25 atm. The resultant vapour is partially condensed at this pressure, the condensate recycled and the remaining gas condensed. W. H. T.

M. Pier. U.S.P. 1,917,324, 11.7.33. Tars or coal paste are hydrogenated at 300°–550° C. and about 200 atm. pressure, the partial pressure of the hydrogen being at least 90% of the total pressure. The high boiling fractions of the resultant product are cracked at a temperature higher than that of the first treatment in order to effect a splitting of the fraction, without substantial hydrogenation, into low boiling hydrocarbons. W. H. T.

C. F. R. Harrison and H. W. Strong. U.S.P. 1,919,108, 18.7.33. Hydrogenation of coal by spraying with a solution of a catalyst, *e.g.*, nickel nitrate or ammonium molybdate, draining and impregnating the material mixed with a suitable oil and hydrogenating at 200 atmospheres pressure and at temperatures of about 420° C. W. S. E. C.

M. Pier. U.S.P. 1,919,857, 25.7.33. Waste hydrocarbon gas from hydrogenation processes is decomposed, by interaction at above 900° C. with carbon dioxide containing gas, into hydrogen and carbon monoxide.

H. W. Fisher. U.S.P. 1,920,140, 25.7.33. Oil containing a suspended catalyst of such density and particle size as to cause rapid settling in an elongated vertical hydrogenation zone is subjected to elevated temperature and pressure. Oily suspension is withdrawn from the lowest part of the zone and returned to the latter at its upper end in admixture with part of the fresh oil. The remainder of the feed, together with hydrogen, is passed through a heating zone and then in the lower part of the body of oil. W. H. T.

929. Patents on Gas.—H. G. Watts and I. C. I., Ltd. E.P. 393,317, 2.6.33. Ethylene is separated from its homologues by dissolving the mixture in kerosine to remove propylene at a pressure of 20 atmospheres and then washing the mixture with an ammoniacal solution of a cuprous salt under the same pressure. The solution is separated from the residual gases and the dissolved ethylene regenerated by heating and reduction of pressure. W. S. E. C.

T. Coxon and I. C. I., Ltd. E.P. 395,028, 13.7.33. Hydrogen sulphide is eliminated from gases by counter current washing with an alkaline suspension of iron hydroxide. Accumulation of ammonium, cyanogen salts is avoided by continuously by-passing a portion of the wash liquor from the scrubber, treating this with ferrous sulphate, returning the precipitate to the system via the air regeneration tank, and discarding the supernatant liquid. S. B.

C. Padovani. E.P. 395,893, 27.7.33. Carbon-black, light hydrocarbons and hydrogen are prepared simultaneously from methane or methane-containing gases by heating to 1000–1300° C. in metal retorts. W. S. E. C.

930. Patents on Motor Spirit. Gulf Refining Co. E.P. 394,511, 29.6.33. The production of an inhibitor resembling in physical properties peri-monoxynaphthalene is described. Alpha naphthol is oxidised with an aqueous solution of a ferric salt, and the inhibitor extracted with benzine or 1.1.8. dioxynaphthalene is dehydrated without oxidation and the reduction product extracted with benzine. W. S. E. C.

Universal Oil Products Co. and A. L. Mond. E.P. 395,448, 20.7.33. Treatment of cracked spirit to remove gum-forming substances by subjecting the spirit in the vapour state to the action of hydrochloric acid in the presence of a solid metal catalyst, *e.g.*, copper and zinc or brass.

W. C. Holmes & Co., Ltd. E.P. 395,635, 20.7.33. Treatment of spirit from cracking or low temperature carbonisation plants to reduce the tendency to form gummy constituents in two stages. 1–1½% by volume of acid tar is used in the first stage to remove chiefly basic substances, and 0·5% of 95–96% sulphuric acid is used in the second stage to remove the more highly unsaturated hydrocarbons. The spirit is then brought into intimate contact with lime and then with caustic soda. W. S. E. C.

F. E. Kimball. U.S.P. 1,917,648, 11.7.33. Hot gasoline vapours are brought into contact with a hot mixture of 3–5% of ammonium chloride and 60–70% of zinc chloride at a temperature of 330–350° F. to cause polymerisation. The vapours containing gums formed by polymerisation are

withdrawn from the mixture and cooled, and the gasoline vapours separated from the gumming liquid.

R.N. Parks. U.S.P. 1,917,899, 11.7.33. Vapours arising from storage receptacles containing gasoline are collected, compressed and cooled, and uncondensed vapours are rectified to recover the gasoline from the hydrocarbon gas. W. S. E. C.

931. **Patents on Lubricating Oil and Wax.** Atlantic Refining Co. E.P. 394,404, 29.6.33.—A high degree of electrical resistance and stability in this respect is conferred on an oil of suitable viscosity primarily refined by a conventional acid and clay treatment followed by fractional extraction with nitro benzene. As the various fractions obtained—*i.e.*, extracts and extracted oil differ widely in their resistance properties according to the type of original oil, testing of each fraction is necessary. Evaluation with regard to resistivity stability is determined by means of a comparison of resistances before and after an oxidation treatment of the sample which consists of maintaining the oil at 100° C. exposed to a current of air for a period of 72 hours.

Burmah Oil Co. and others. E.P. 394,414, 29.6.33. Oil-wax mixtures are treated by agitation with anhydrous aluminium chloride or an analogous anhydrous chloride at a temperature just above the melting point of the mixture. After separation of the chloride sludge. The oil and wax are easily separated from each other in a refined state. The process is also applicable to reduced crudes and to scale wax. S. B.

Yacco, S.A.F. E.P. 395,867, 27.7.33. Production of lubricating oils, in which ·25% of a soap having a metallic base; e.g., copper oleate together with 2% of stearate and oleate of ammonium are dissolved in a solvent consisting of one or more vegetable oils such as arachide oil, olive oil and soya oil in quantities amounting to 7·75%. The solution formed is combined with 90% of one or more mineral oils.

Timken Roller Bearing Co. E.P. 395,976, 27.7.33. A machine is described for testing the abrasive and scoring or roughening characteristics of lubricants. It consists of a rotatable test ring and a pair of levers the upper lever being fulcrummed on the lower and carrying a test block adapted to make line contact with the test ring. W. S. E. C.

F. W. Sullivan, Jr., and E. C. Adams. U.S.P. 1,917,910, 11.7.33. Separation of oil from wax by adding porous cellular silica and then diluting the mixture with a diluent containing an ester of a monocarbon organic acid; e.g., 36–72% of ethyl carbonate and 64–28% of benzene.

H. L. Allam. U.S.P. 1,918,009, 11.7.33. A wax-sweating plant comprising a deep-closed vessel, the external walls of which are insulated or lagged so that it can be used in the open for heat treatment of wax or wax mixtures.

L. J. Ireland. U.S.P., Re. 18,898, 18.7.33, original No. 1,851,432, 29.3.32. Used lubricating oils are reclaimed by leading the oils, together with acidulated clay, into a heating zone where the mixture is heated without cracking. A stream of air is drawn through the zone and the mixture is drawn off and filtered in a separate zone.

W. G. Hoffman and J. R. Miller. U.S.P. 1,919,655, 25.7.33. A method similar to the above, but utilising a mixture of 1lb. of sodium carbonate to 1lb. of diatomaceous earth to 10 gallons of oil.

C. J. Rodman and R. P. Dunmire. U.S.P. 1,919,669, 25.7.33. Insulating oils of high dielectric strength are prepared by heating a mineral hydrocarbon oil produced by heating an oil below 120° F. and spraying under superatmospheric pressure into a high vacuum zone in order to remove moisture and gas from the oil.

T. B. Wayne. U.S.P. 1,919,871, 25.7.33. Separation of oil and water emulsions by adding an agent comprising a complex condensation product of a phenol, a polyhydric alcohol; e.g., ethylene glycol, an aldehyde, a fatty acid having more than 8 carbon atoms; e.g., oleic acid, a nuclear substituted aromatic sulphonic acid and an alkylamine containing a hydroxylated aliphatic group. W. S. E. C.

F. X. Govers. U.S.P. 1,920,125, 25.7.33. Manufacture of lubricating oil of low pour test and high viscosity index. A distillate cylinder stock free from gas oil is treated with acetone to remove constituents of low viscosity index. The undissolved constituents are mixed with acetone and benzole, the mixture chilled to 0° F. and solid hydrocarbons removed followed by evaporation of the solvent.

H. M. Rosen. U.S.P. 1,920,161, 25.7.33. A lubricant consisting of paraffin, petroleum jelly and oil in the proportions of 50, 30 and 20 parts, respectively. The lubricant is stated to be a brittle solid of melting point above 113° F. W. H. T.

932. Patents on Kerosine. E. Saegebarth. U.S.P. 1,917,736, 11.7.33. An improvement in the treatment of moisture-containing liquid hydrocarbons with liquid SO_2. The first stage extract evaporation is conducted at condenser pressure, the SO_2 being dried and added to the undried SO_2 evolved from the other stages. By this means, accumulation of water in the treatment cycle is prevented. W. H. T.

933. Patents on Special Products. Bataaf. Pet. Maat. E.P. 393,152, 1.6.32.—Synthetic alcohols free from obnoxious odours are obtained by agitating the diluted alkyl sulphuric acid with Edeleanu, fururol, acetone, or similar extract from mineral oil. The extract has a preferential solvent action on the bad smelling compounds present and should have a boiling range sufficiently remote from that of the alcohol being treated so that contamination is avoided on subsequent redistillation. S. B.

Deutsche Gold- und Silber Scheideanstalt. E.P. 393,266, 22.5.33. Water-free alcohol is prepared by using dehydrating salts consisting of a mixture of alkali or alkali earth salts of fatty acids. W. S. E. C.

H. Dreyfus. E.P. 394,375, 394,389, 22.6.33. Preparation of ethanol and other alcohols and diethyl ether and other ethers by the hydration of olefines with water vapour in the presence of a pyro-sulphate which is stable under the reaction conditions (150—350° C. and pressures up to 25 atm.).

E.P. 394,389 specifies the use of phosphoric acid. W. S. E. C.

H. Dreyfus. E.P. 394,674, 22.6.33. Manufacture of ethyl alcohol and diethyl ether by hydration of ethylene. Mixtures of ethylene and steam are brought into contact with a liquid catalyst; e.g., an alkali metal metaphosphate at a temperature above 100° C. and under 25 atmospheres pressure. W. H. T.

R. G. Walker. U.S.P. 1,919,644, 25.7.33. Dry cleaners' solvent is purified in a small treating tank by allowing it to flow in an endless ring in intimate contact with a decolourising agent and then centrifuging it to separate the solvent from heavier impurities. The solvent is distilled to eliminate high-boiling hydrocarbons, distillate being returned to the endless ring. W. S. E. C.

934. Patents on Refinery Plant. C. R. Wagner. U.S.P. 1,916,450, 4.7.33. —A furnace and pipe heater for use with a vapour-phase cracking process.

H. G. Schnetzler. U.S.P. 1,916,690, 4.7.33. Fractionating column with means for returning a part of the condensate to serve as reflux.

R. E. Burk. U.S.P. 1,917,357, 11.7.33. A furnace and pipe heater for use with a cracking plant.

W. K. Lewis. U.S.P. 1,919,594, 25.7.33. Process and apparatus for distilling liquids from their solutions in less volatile solvents (e.g., natural gasoline from absorption oil). W. H. T.

Class 700. Utilisation.

935. Explosions of Methane and Air: Propagation Through a Restricted Tube. H. Robinson and R. V. Wheeler. *J. C. S.*, 1933, 758–760.—The work described is an extension of experiments recorded by Chapman and Wheeler (ibid., 1926, 2139). A steel tube 32·3 metres long and 30·5 cms. in diameter, open at both ends, was fitted with 11 rings at intervals of 30·5 cm. Each ring reduced the diameter to 10·2 cm. An explosive mixture was used which contained 9·8–10% methane in air, and ignition was from a point near one end of the tube. The latter was fitted with a series of small windows. Photographic records showed that soon after the flame entered the restricted zone, it attained a high speed and its progress was signalised by a sharp report similar to that accompanying detonation. Ultimately a speed of about 450 metres per sec. was reached between restricting rings Nos. 10 and 11. This speed was attained from about 2 metres per sec. within 0·01 second, but the acceleration was smooth and continuous. Beyond the restricted zone, the flame speed steadily decreased to about 300 metres per sec., and then gradually increased to about 600 metres per sec., as the open end of the tube was approached. Hence a constant regime comparable with that of the detonation wave was not established in the last unrestricted portion of the tube. W. E. J. B.

936. Explosions of Mixtures of Hydrogen and Air: The Specific Heats of Steam at High Temperatures. G. B. Maxwell and R. V. Wheeler. *J. C. S.*, 1933, 882–885.—These authors describe explosion experiments with hydrogen-air mixtures from which mean apparent specific heats of steam, at constant volume, from 15° C. to temperatures around 2000° C., have been calculated. These values range from about 9·5 to 11·5. The authors conclude that they cannot accept recent criticism put forward against this method, viz., that a loss of energy occurs due to incomplete combustion of hydrogen at the moment of maximum pressure. They consider that the values for the mean specific heats of steam at constant volume at high temperatures, accepted by Partington & Shilling, are too low. W. E. J. B.

937. Oil Engine Development. P. N. Everett. *J. Inst. Petr. Techn.*, 1933, **19**, 600–616.—An account, with illustrations, of the development of stationary engines, marine engines, engines for locomotives, engines for road vehicles and engines for aeroplanes. G. R. N.

938. Performance of Cars and Volatility of Fuel. G. G. Brown. *Oil & Gas J.*, 18.5.33, **31** (52), 51.—The effect of anti-knock value on the performance of a car is generally appreciated and can be given quantitative significance by means of the octane numbers. The effect of fuel volatility on performance is also generally appreciated, but no method of ascribing a quantitative significance to volatility has been developed. The need for a simple numerical statement of effective volatility is stressed, and the volatility index proposed by Oberfell and Alden (*cf.* Abstr. 248) is a step in the right direction, even if it does not prove to be the most satisfactory method. The work carried out by the Natural Gasoline Association shows that the acceleration of a car

can be definitely related to the mixture ratio of the charge burned in the cylinders during the accelerating period. It was generally found impossible to increase the speed of the engine when the proportion of air to gasoline burned in the cylinders exceeded 20 to 1 and this mixture ratio is taken as representing zero acceleration or performance. The maximum possible acceleration is usually obtained when the mixture ratio is 12 to 1, which is taken as representing 100% performance. A table is given showing per cent. performance in multiples of 10 and the corresponding air-fuel ratios, based on increase in speed obtained in about 10 secs. at the indicated air-fuel ratio, divided by the maximum acceleration with an effective air-fuel ratio of 12 to 1.

Combining this information with that previously obtained relating effective volatility at any mixture temperature and air-fuel ratio to the A.S.T.M. distillation curve of the fuel, three charts are drawn to enable determination of the performance of a given fuel at various atmospheric temperatures from the A.S.T.M. distillation curve of the fuel. The curves relate to : (*a*) motors without adequate accelerating device and radiator shutters, but with mixture temperatures about 90° F. above atmospheric when motor is warm; (*b*) modern type cars fitted with accelerating device, etc., and thoroughly warm ; (*c*) as in (*b*) but starting from cold.

Although the 70% and 90% distillation temperatures of fuels having the same 50% temperature may differ by as much as 40° F., the differences in the 10% and 30% distillation temperatures are usually much less. The effect of the earlier portion of the A.S.T.M. curve on performance is the greater, so the volatility index may be used for the purpose of determining performance without introducing serious error. Decreases in torque observed when operating a N.A.C.A. Universal engine on fuel of 78 octane number, adjusting the engine to run with : (1) no audible knock ; (2) max. power with audible knock when the spark is (*a*) adjusted for max. acceleration ; (*b*) maintained constant, and then using fuels of lower octane number under the same conditions, are translated into percentage performances, taking 100% as representing the torque obtained with the 78 octane number fuel. Most modern cars are equipped with automatic spark control, so conditions (1) (*b*) would indicate the normal loss in performance on acceleration if the car were adjusted to operate so that a fuel of 78 octane number was required to eliminate audible knock during acceleration. Under such conditions the use of a fuel of 66 octane number would result in a loss in performance of 2%. This is approximately the same loss as would be experienced by using a fuel having a volatility index 10 units lower than that required for maximum performance under conditions of test. In the critical range, where performance suffers by the use of a fuel of lower volatility index or lower octane number, these two properties seem to be of approximately equal numerical importance. R. A. E.

939. Comparison of Supercharging Systems for Marine Diesel Engines. A. Büchi. *Trans. Inst. Mar. Eng.*, 1933, **45**, 105–128.—This article is a detailed comparison of the various methods of supercharging marine Diesel engines, and makes reference also to special problems relating to same and recent methods of dealing with them. Special reference is made to the Büchi system of exhaust turbo charging, which is at present being widely adopted. C. H. S.

940. Motor Fuel from Coal and Oil Shales. A. Fisher and J. C. Morrell. *J.S.C.I.*, 1933, **52**, 228T–230T. This paper is concerned with the cracking of tars derived from coal or shale, with the object of obtaining motor spirit. Complete and detailed data on the above is presented where cracking was conducted

at 200 lb. pressure, with transfer temperatures (from coil to soaker) of 482° C. approx., to yield raw distillate, residuum and gas. For example, a low temperature tar from German brown coal gave a 55·5% volume yield of raw motor spirit, which after removing tar acids and bases, by washing with solutions of NaOH and dilute H_2SO_4, was treated with a normal conc. H_2SO_4 acid treatment to give a fuel of gravity 0·775, colour 22 Saybolt, doctor and corrosion negative, sulphur 0·39%, octane number 79, I.B.P. 53° C., 20% 110° C., 50% 149° C., 90% 191° C., F.B.P. 205° C.

Similarly, shale oils gave good results.

Results with high temperature tars indicated the refractory nature of such materials which are not suitable for the production of motor spirit by cracking. This unsuitability appears to be possessed by the tar acids found in high temperature tar which, in contrast to those found in low temperature tar, are extremely refractory. The results obtained appear to have a direct relationship to the C/H ratio differences in the charging stocks, which insofar as tars are concerned can serve as a guide to expected results. W. E. J. B.

941. Alcohol-Petrol Mixtures. Anon. (from a paper recently presented to the A.S.M.E.) *Auto. Eng.*, 1933, **23**, 238.—The situation in regard to the use of alcohol-petrol mixtures as motor fuels is discussed. These mixtures can be used satisfactorily in place of petrol, but cost more per gallon and give slightly fewer miles per gallon. The danger of separation with water is mentioned. An advantage of the blends is increased anti-knock value. The alcohol may be produced from agricultural products such as corn, potatoes or molasses, or by hydrolysis of wood to glucose and fermentation. It may be produced, however, from petroleum or coke oven gas. In Sweden blends of 75–80% of petrol with 20–25% of alcohol are used. Much attention has also been given to the use of alcohol in France, Australia and America, the main object being to help the home agricultural industry. An important question is, however, whether the alcohol can be prepared in the required anhydrous state more cheaply synthetically than from agricultural products. E. B. E.

942. Preservation of Building Materials. A. W. Rick. *Bitumen*, 1933, **3**, 118–120.—The many agencies through which damage may occur to building materials are discussed. Protective measures may be of two kinds: (1) "active," in which the resistance of the surface to damage is increased by suitable treatment; (2) "passive," by excluding completely the corrosive materials. In the second group, bitumen and its mixtures are particularly valuable, as it possesses good mechanical properties, is insoluble in water, unattacked by chemicals, while it has, in addition, a high electrical resistance.

Bitumen may be applied hot, in solution, or as a stable aqueous emulsion. By mixing the latter with sand and filler, a mortar may be obtained similar to the usual lime or cement mortar.

Finally, certain uses of bitumen in this connection are mentioned. C. C.

943. Investigation on Bituminous Roads—Particularly Fine Asphaltic Concrete. Bierhalten. *Bitumen*, 1933, **3**, 90–97.—This article deals first of all, in a general way, with specifications from the point of view of the contractor. Particular reference is made to the German Specification DIN 1995/96, which is critically discussed. The author takes certain aspects of this specification in regard to fine asphaltic concrete to illustrate his views. The question of the voids in the mineral structure and the influence of the latter on the properties of the final material are discussed. The bitumen content and the granular composition of the mineral matter, together with the

hardness of the bitumen, play an important part in the properties of this material.

These questions are discussed in the light of the requirements of the DIN specification. C. C.

944. Bitumen and Tar in Modern Road Construction. Otten. *Bitumen*, 1933, **3**, 97–101.—The differences between bitumens and tars are described. Generally speaking, the cohesion of the binder should be less than its adhesion. The behaviour of these materials as binders is discussed, and the effect of temperature indicated. It is desirable that the difference between freezing and dropping points should be as great as possible. Viscosity/temperature curves are given for two tars—a soft pitch, a bitumen and a cut-back bitumen. The thinner tar and the cut-back are less susceptible to heat. In some respects bitumen possesses advantages. Experiments were carried out on two bitumens (softening point, K. & S., 26° C. and 35° C.) and two tar residues (softening point 23° and 27°). The penetration of the bitumens varies from 194 to 6 and 101 to 3 respectively between 25° C. and –20° C. in the two cases. The tars, on the other hand, varied from 280 and 184 at 25° C. to 2·5 at 0° C. and 5 at 5° C. The tars were hard at –0·5° C. and +1° C. respectively. Greater differences are shown for the ductility, which in the case of tar changes from 0 to 150 over 1° C. C. C.

945. Cold Mixing of—and Cold Construction with—Tar Concrete and Asphaltic-Tar Concrete. O. Huber. *Asphalt u. Teer*, 1933, **33**, 425–427.—The use of the above materials is discussed for the preparation of light surface dressings. The advantages of this type over the original hot mixtures are emphasised. Certain test-stretches of road were prepared and subjected to severe weather conditions. Details are given of the mineral aggregate and of the binder. An important consideration in the case of the latter is the boiling point of the solution material. In order that this may escape readily from the compressed mass so that the coating rapidly acquires sufficient solidity, the boiling point should be low. (In the case given, the upper limit of the boiling range of the flux is 140° C.)

A second binder mixture consisted of 60% of asphalt (penetration 200) containing 20% of tar- or creosote-oil and 40% of special tar. The procedure adopted for applying the tar-mineral mixtures is described. After a period of service, portions of three different surface coatings were removed and fully examined, the results being given in a table. C. C.

946. Bitumen in the Paper Industry. E. Belani. *Bitumen*, 1933, **3**, 120–124.—Bituminised paper and cardboard have many uses, which are enumerated. Not only are they used for wrapping articles which require special protection against moisture, but they are of great value for protecting metal surfaces against corrosion, for electrical insulation, etc. In recent years, paper of this type has found considerable application in the sugar plantations in Hawai. The paper is laid on the ground between the rows and prevents the growth of weeds. Later experiment showed that if the ground is covered with this treated paper, while the sharp end of the sugar cane can penetrate the paper, the weeds do not. The ground retains its moisture while the higher temperature thus maintained promotes the growth of certain important micro-organisms. Recent experiments have shown that much heavier crops are obtained also with tomatoes, potatoes and beans by this method.

Methods for impregnating the paper may be roughly divided into four classes :—

(1) Saturating in a bath of heated bitumen. Plant for this process is illustrated and described. The temperature is maintained at 160–180° C.,

and the apparatus is so designed that the period during which the paper is immersed can be varied to suit papers of different weights, the time of immersion varying from 6 to 90 seconds.

(2) Coating the paper in a rolling machine. In this process, the paper passes under a roller dipping in molten bitumen, then between this and another roller running against the upper part of the first, whereby the thickness of the coating can be adjusted. After this, the paper is conducted over a heated cylinder (to produce a smooth surface), and finally the coated paper is cooled by air jets as it passes a further series of rollers.

(3) Coating by spraying. This is a simple and cheap method for finished paper goods and cartons.

(4) Direct mixing of bitumen in the form of aqueous emulsion with the paper pulp.

Finally extracts are given of a series of patents by L. Kirschbraun dealing with the use of emulsions. C. C.

947. Preparation and Use of Bituminous Paints. Anon. *Revue des Produits Chimiques*, 1933, **36**, 193–198; *Oil & Colour Trades J.*, 1933, **83**, 1533.—Materials used in the preparation of asphaltic paints include asphaltites such as gilsonite, etc., natural asphalts of the Bermudez or Venezuelan type, and petroleum residues either as such, blown or sulphurised. The impurities in natural asphalt are removed by heating and settling. Blown bitumen is very elastic, has low susceptibility to temperature changes, and is resistant to vibration and cold. It is used in very high quality stoving enamels for protecting pipes, chimneys, flues, etc.

Asphalts, even those of similar appearance and physical properties, vary considerably as to opacity and colouring ability, the harder and more brittle materials having greater density and darker colour. The dense asphalts do not dissolve as readily in turpentine and white spirit; varnish asphalts should not, therefore, be too hard. Hard asphalts are used in cheap varnishes, mixed with large amounts of rosin, when they remain in solution without excessive formation of foots. Varnish asphalts are selected according to their colouring ability, which is estimated by dissolving 10 gms. of asphalt and 40 gms. rosin, heated to 115–120° C. in 100 ml. turpentine; 10 ml. of this solution are then diluted to 100 ml. with white spirit, and the colour of the solution is compared with a similar solution of a standard asphalt. Materials used for roadmaking and similar purposes are not suitable for paints.

It is usually necessary to blend several asphalts to obtain the desired properties, and experience is essential, since very surprising results may be obtained owing to the interaction of the constituents of a mixture. Asphaltic paints tend to thicken and coagulate, and solution should be carried out while the bitumen is warm, care being taken to melt the bitumen as quickly as possible and to avoid overheating, since the presence of free carbon affects the appearance and rate of drying of the paint.

Although more suitable as solvents, aromatic hydrocarbons are not used to the same extent as white spirit, owing to their poisonous fumes. Asphaltites and blown bitumen require more solvent than steam reduced residues. Natural asphalts dissolve readily in naphtha, xylol, etc., without the addition of other materials, but the varnishes can only be used for rough work or for metal surfaces where temporary protection is required, since the asphalt film is quickly broken by expansion and atmospheric action. This also applies to cheap varnishes not containing oil or other materials to render the film plastic and resistant to atmospheric action. When a good paint is to be applied to a surface previously coated with such materials, care should be taken to remove the old film completely.

The flexibility and mechanical resistance of a paint film are increased by the addition of wool grease, tallow, stearine, pitch, etc.; this also increases the adhesivity of the paint. Linseed and tung oils may also be added, but mineral oils, although sometimes used, are not satisfactory for this purpose. Cheap varnishes, of coal tar pitch dissolved in crude naphtha, are sometimes used to adulterate asphalt varnishes.

Asphaltites, although much less ductile than residual bitumen, are much more elastic; blowing at 104° C. is, however, sufficient to impart good qualities to residual bitumen.

Bituminous paints are divided into three classes as follows: (1) Varnishes obtained by dissolving asphalt in volatile solvents, such as benzole, solvent naphtha, turpentine, white spirit, carbon tetrachloride, etc.; these paints dry very rapidly. The white spirit should conform to B.S.S. No. 245, 1926. (2) Fatty varnishes which include linseed oil and rosin oil, as well as the volatile solvent varnishes. (3) Mixed varnishes including, in addition to the above, mixtures of asphalt, natural and synthetic rosins, and gums, etc. These varnishes are distinguished by their resistance to atmospheric action, water, oil, etc., and by their hardness and polish. They are used on the chassis of automobiles.

In varnishes containing drying oils, bitumen, especially residual bitumen, retards drying, which is therefore accelerated by increased addition of driers.

The value of asphalt is due to its general resistance to atmospheric action and its waterproofing ability; it is non-poisonous and does not taint water; it is also distinguished by its high dielectric properties and, for this reason, bituminous paint is used as an insulator in the electrical industry. A. O.

948. Heavy Residuals are the Main Lubricating Component of Motor Oils. P. M. Robinson. *Nat. Petr. News*, 5.7.33, **25** (27), 29–32.—The superiority of residual bright stock over distillates as automobile lubricants is discussed. It is pointed out that bright stock is more resistant to sludging and oxydation than distillates. A lubricant is looked upon as a blend of "polar compounds," the real lubricants, in a medium which acts as a vehicle, and it is stated that bright stock contains a higher proportion of "polar compounds" than distillates. Moreover it is contended that "dewaxing" and filtering processes involving the use of clays reduce the content of "polar compounds." Hence the use of inhibitors of the crystallisation of wax is to be advocated. H. G.

949. Refining Used Automobile Lubricating Oil. E. C. Pattee. *Nat. Petr. News*, 12.7.33, **25** (28), 29–30.—The article contends that provided the proper process is used it is possible to prepare satisfactory automobile lubricating oils from crankcase drainings. A table gives the properties of the oils recovered from an average sample of drainings by a variety of processes. It is known that appreciable quantities of gums, resins, organic acids and unsaturated bodies are detrimental to a lubricating oil and the refining process must be designed to remove all these. H. G.

950. Gas Fuel Improves Lime Kiln Efficiency. J. B. Nealy. *Chem. Met. Eng.*, 1933, **40**, 356–357.—The burning of lime has generally been accomplished with the aid of crude fuels, wood and coal. Recently natural gas has been adopted, and it has been found that with this fuel the kiln capacities were increased by more than 50%, considerable labour was eliminated and a better and more uniform product was obtained. The gas burners used were of the simplest type. G. R. N.

See also Abstracts Nos. 867, 915, 918, 919, 921.

ABSTRACTS.

Class 100. Geographic Occurrence.

951. Pipe-Line Operation in the United States, 1932. Anon. *Pipe Line News*, Aug., 1933, **5** (9), 3–8.—The greater part of the Inter-State Commerce Commission's report on the operations of American oil pipe-lines during 1932 is reproduced. The report shows that the total mileage of trunk and gathering lines in 1932 was 92,782½ miles, a decrease of 307½ miles from the 1931 figure. Trunk line mileage increased 117½ miles to 51,404½ miles, but gathering lines decreased 425 miles to 41,378 miles. The forty-nine companies covered by the report transported 508,087,978 brl. of crude oil and 24,907,805 brl. of refined oils in 1932, all of which originated on the line. The total shipments of oil carried, including duplications, was 1,120,848,200 brl., as compared with 986,953,284 brl. in 1931. W. W.

952. Distribution of Oil Pools in Kansas in Relation to Pre-Mississippian Structure and Areal Geology. J. L. Rich. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 793–815.—This paper deals with the geological and structural features of Kansas which prevailed at the time when, according to a previous theory outlined by the author, oil produced in South Oklahoma may have migrated northwards.

The general location of accumulation to be expected by that theory is deduced, and a comparison of results is made with the actual distribution of oil accumulation as now known. This distribution is also shown on a map with the pre-Mississippian areal geology superimposed, and the facts involved are summarised and interpreted.

A map is also given showing the principal structural features revealed by the pre-Mississippian geology. The most important of these features controlling oil accumulation, would appear to be the Central Kansas arch. This is a broad geanticlinal uplift in the form of an open arc extending W.N.W. across the State.

The paper contains a very full and interesting discussion of eight pages. G. S. S.

953. East Texas Oil Field. H. E. Minor and M. A. Hanna. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 757–792.—The East Texas Oil Field (approx. 110,000 acres in extent) occurs within the broad belt of Cretaceous and Tertiary rocks, bordering the Gulf of Mexico, which are unconformably overlapped by pre-Cretaceous deposits of the interior.

The producing horizon is the Eagle Ford-Woodbine group. This consists of varied-coloured shales, sands, and silty and sandy conglomerates. Owing to the definitely non-marine character of the beds, numerous disconformities and much cross bedding occurred during their deposition; they vary therefore both horizontally and vertically. In thickness, the group ranges from almost zero on the east to possibly 1000 ft. in the centre of the basin.

Tests on the porosity and permeability of the sands are given, an average porosity of 19% being proved from 25 cores taken from 10 representative wells. This is not exceptional, however, and falls within the average range of porosities of sands from many other fields. The permeabilities are high, tests giving an average of 1·0 for distilled water; sands from other good producing fields having permeabilities of only 0·1 or less.

Structurally, the field consists of a westwardly dipping, truncated homocline, and a section and structural contour map are supplied in illustration.

Production is restricted at the present time (Jan. 1, 1933) to a flow of 28 brl. per day per well, the approximate number of producing wells being 9600. Estimates of the total production vary from 1 billion to 2 billion brls., while the actual potential production of the field is estimated to vary from 2–4 million brls. per day. G. S. S.

954. Geology and Occurrence of Natural Gas in Amarillo District, Texas. V. Cotner and H. E. Crum. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 877–906.—The Amarillo district includes the Hugoton area (S.W. Kansas), the Oklahoma Panhandle, Texas Panhandle and the Sayre district of S.W. Oklahoma. The geological formations which occur include those of the Tertiary, Cretaceous, Triassic, Permian, Pennsylvanian, and (?) Mississippian and Ordovician; a correlation table is given.

The producing horizons are the Permian dolomite series, and the "Gray Lime" and Granite Wash—both of Pennsylvanian age. The dolomite series consists of buff to white crystalline dolomite interbedded with grey shale and is the most widespread gas producing horizon. In the "Gray Lime" the source of the largest gas wells occurs in the western and northern counties of the Texas Panhandle. The Granite Wash, where most productive of gas and oil, consists of coarse arkosic sand and gravel. Gas wells have also been found locally on weathered surfaces and in fractures of the granite. A distinguishing feature of these horizons is their remarkable continuity, the dolomite occurring practically without interruption and having a porosity uniform through the district. The Gray Lime, although only present in the ridges, is responsible for accumulation in a continuous band 60 miles long; while the Granite Wash constitutes a producer in a continuous band for over 70 miles.

The structure of the rocks consists of a broad anticlinal fold superimposed over a buried mountain range (the Amarillo Mountains). A map and several sections in illustration of this structure are given.

Consideration is also given with regard to the origin and accumulation of oil and gas, and two likely sources are quoted and discussed: (1) from source beds of pre-Pennsylvanian age and (2) from source beds of Pennsylvanian age. Data concerning production is furnished in detail. Natural gas has been known to exist in the district since 1918, from which time it has developed rapidly in economic importance, and now occupies first place in production of natural gasoline and carbon black. G. S. S.

955. Driscoll Pool, Duval County, Texas. I. R. Sheldon. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 816–826.—The Driscoll Pool is located in Central Duval County and comprises 53,000 acres. No topographic maps are available, this being the only part of south-west Texas that has not been mapped by any branch of the Government.

The surface rocks are made up of sands and clays of Pliocene age (Reynosa or Lower Lissie), but they are mainly covered by caliche and gravels of recent age, which makes surface geology unreliable. Information obtained from well logs proves the underlying rocks to range in age from Miocene to Eocene (Cook Mountain formation). No definite limestones are present, and correlations have to be made almost entirely on sands and sandy shale.

Structurally, the area appears to be similar to other producing areas in the Laredo district, in that accumulation results from sand lensing controlled by folding.

Production is obtained from the Oakville (Miocene), Frio (Oligocene) and

Fayette (Eocene) Sands, oil from the latter being 23° Bé gravity of Mirando quality. It is stated that the present three wells will produce approximately 500,000 brls. of oil or a per-acre yield of 16,500 brls. A table of the detailed record of the wells and one showing estimated future production is also given.

Surface and sub-surface maps, together with a generalized cross section, accompany the paper. G. S. S.

956. Structure and Statigraphy of the Kelsey Anticline, Upshur County, Texas. A. R. Denison, A. E. Oldham and S. W. Kisling. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 656–679.—This anticline was first demonstrated as an inlier of Wilcox surrounded by Carrizo, Reklaw and Queen City beds. It is a broad, wedge-shaped structure pointed towards the south. The closure in the outcropping structure is about 100 ft., but in the sub-surface structure of the Upper Cretaceous the closure is 300 ft.

A stratigraphical succession of the Comanche, Cretaceous and Eocene is given, and the structure at successive horizons is indicated by a set of stratum contours maps.

It is shown that the structure was a favourable one for oil, yet, in spite of this fact, drilling had been unsuccessful. The authors conclude from the structural evidence that the structure was not closed until Wilcox time, and that this accounts for the lack of oil accumulation in the Woodbine and other members of the Gulf Series. V. C. I.

957. Analysis and Effects of Current Movement on an Active Fault in Buena Vista Hills Oil Field, Kern County, California. T. W. Koch. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 694–712.—The Buena Vista anticline lies on the west side of the San Joaquin Valley. Its southern flank is traversed by an important thrust which appears to be still active and produces distinct physiographic evidence of its position. Associated with this there has been buckling of gas, oil and water lines along the fault trace. In the wells there has been collapse and parting of the casing in no less than 22 cases, which can be ascribed to movement along this thrust plane. In some cases the suggested movement is claimed to have been 15½ inches.

The fault appears to be a case of slipping along the bedding planes and is a low angle thrust. The main anticline is geologically very young, and the movement in this area appears to be part of the general processes of readjustment in the west San Joaquin valley in the area adjoining the San Andreas fault. Other evidence of recent movement in adjoining areas is brought forward to support the general conclusions.

The paper is illustrated by photographs of the surface effects of the thrusting movement and by maps and sections of the structure. V. C. I.

958. Bitumen Production in Germany. C. Heinrici. *Bitumen*, 1933, **3**, 142–146.—A table shows the German requirements together with imports and exports of asphalt-rock and natural asphalt for 1927 to 1931. The requirements fell from a maximum of 158,000 tons in 1928 to 69,000 tons in 1931. The world production of bitumen from petroleum has increased from 23,528 tons in 1902 to 3,494 thousand tons in 1930. Comparing 1929 with 1930, the production in Europe has increased, but the total production (mainly in America) has decreased. A second table shows the production in Germany of bitumen and natural asphalt for 1925–1930. A diagram shows how the imports of bitumen have fallen (over 200,000 tons in 1928 to 25,000 tons in 1932) as the home production has increased. The latter has been fairly uniform at somewhat over 250,000 tons since 1930. C. C.

959. Petroleum Production of Roumania, January—June, 1933. *Mon. Petr. Roum.*, 1933, **33**, 857–859.—Tables are given which compare the production of crude petroleum from various districts for the periods January–June, 1932, July–December, 1932, and January–June, 1933. A further table indicates the relative values of the quantities of crude produced, drilling undertaken, and prices of crude and products obtained for the years 1929, 1930, 1931, 1932, and January–June, 1933. Other figures indicate the activities of the various fields and companies. W. E. J. B.

960. Petroleum Prospects in the Persian Gulf. *Stand. Oil Bull.*, July, 1933, **21** (4).—The July issue of the *Standard Oil Bulletin*, published by the Standard Oil Company of California, contains an article dealing in a general way with the activities of the company's subsidiary, the Bahrein Petroleum Company, Ltd., on Bahrein Island, and with the prospects of finding an oilfield of sufficient size and productivity to warrant commercial development. W. W.

Class 200. Geology and Origin.

961. Importance of Foraminifera and Heavy Minerals for the Identification of Petroleum Strata. I. D. Matecsco. *Mon. du Petr. Roum.*, 1933, **33**, 875–879.—This article describes the work of Eichenberg and Wager, carried out at the Academy of Mines, Freiberg, and gives in detail their methods for the extraction of fossils of microscopic dimensions from marlaceous and limestone clays. Samples of clay from the lower Cretaceous layer were obtained from the Braunschweig district (North Germany) and examined. About 1000 gms. of clay are boiled in about a litre and a half of saturated sodium sulphate solution. On cooling, the recrystallisation of the salt effectively breaks up the clay and yields a muddy liquid. This is transferred to a washing apparatus (illustrated) and the fossils eventually washed free of clay.

The results obtained are described in detail and 57 different varieties of foraminifera have been noted for the Albian of Wenden.

The heavy mineral content of petroliferous sands can also be examined in a somewhat similar way, except that separation is effected using bromoform (sp. gr. 2·84). It is concluded that it is quite possible to characterise the five horizons of the lower Cretaceous layer by consideration of the fossils only. W. E. J. B.

962. Results of the A.P.I. Research Project on Origin and Environment of Source Sediments. P. D. Trask. *Proc. A.P.I. Prod. Bulletin No.* 211, May, 1933, 19–31.—The Institute has been sponsoring an investigation of source beds of petroleum for seven years. The main economic objects of this work are to lessen the cost of exploration for oil and to facilitate the finding of new oilfields. Five years were devoted to the study of sediments as they are now accumulating beneath the sea. The results of this phase of the investigation have been published, but a brief summary is included in this paper. The last two years have been devoted to the study of ancient sediments from oilfields. The U.S. Geological Survey has been supporting this phase of the work jointly with the Institute. This work has progressed sufficiently to present several results, the most important of which are :—

1. The period of time shortly after the deposition of sediments probably is of major importance in the generation of petroleum.
2. There may be more than one period of generation of petroleum from the same sediments.

3. Sediments containing a small amount (1·5%) of organic matter may be good source beds of oil.

4. Fine-grained sands under certain circumstances may be source beds of oil.

5. The remarkably uniform and low organic content of the 27,000 ft. of the Shasta series occurring on the west side of the Sacramento Valley, California, indicates that no particular part of these sediments is likely to be better source material of oil than any other part. W. W.

963. Role of Cap Rock in Oil Accumulation. R. P. Lockwood. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 713–731.—This is an account of experimental work on the accumulation of oil in salt water sands, firstly under an impervious cap rock, and secondly with a porous cap. In the first case the attempts to produce an oil accumulation failed, while with the porous cap rock the experiments were successful. Gradually the cap rock appeared to become sealed by a process which is claimed to be due to the cohesive and adhesive properties of oil increased by changes in the latter as the result of chemical changes. This process of differential adhesion gradually seals the cap rock and traps the oil. The latter may be augmented by the cohesion of oil brought into contact by circulatory waters.

It is also concluded from the experiments that oil will not migrate under static conditions through buoyancy alone, and it is claimed that the oil which adheres to the sand for some time becomes held fast by chemical reactions at the oil-water interface, which increase the viscosity of the oil. Capillarity action as a selective screen retaining the oil is also condemned, and the author claims that oil migrates and accumulates under conditions which are essentially dynamic, but are less active than hydraulic flushing. V. C. I.

964. New Method for Very Accurate Magnetic Measurements. T. Koulomzine and N. Bondaletoff. *Ann. des Comb. Liq.*, 1933, **8**, 549–558.—It is considered that the Askania magnetometers of earlier design (1924–31) are capable of giving results accurate to ± 5–$6\,\gamma$. ($1\,\gamma = 1 \cdot 10^{-4}$ c.g.s.) Later models, however, are capable of better accuracy. The authors outline a mathematical treatment whereby it is possible, even with the earlier type of Askania instrument, to obtain an accuracy of $\pm 1\,\gamma$. W. E. J.'B.

Class 300. Development and Production.

965. Combination Portable Drilling Machine and Rotary Rig. G. Graham. *Petr. Eng.*, Aug., 1933, **4** (12), 30.—A description of a combination of a portable drilling machine and standard rotary unit capable of drilling shallow wells is given. A well 2537 ft. deep was drilled with this unit in the actual drilling time of 27 days, including repair time, this being only about six days slower than that possible with a heavy rotary. L. V. W. C.

966. Proper Wire Rope Lubrication. A. J. Morgan. *Power*, Aug., 1933, **77**, 430–431.—A wide diversity of opinion exists on lubrication practice for wire rope. This Mr. Morgan reviews and then gives the fundamental qualities necessary in a good lubricant to act both as a protector and a lubricant. Methods of applying lubricant to wire ropes are outlined. W. W.

967. Influence of Subsurface Conditions on Cementing Casing. W. A. Sawdon. *Oil Weekly*, 4.9.33, **70** (12), 20.—A definite increase in the value of a well is obtained when the casing is effectively cemented, and this can only be realised when certain factors are properly understood.

The character of the formation influences the selection of the point where casing is to be set and efficient coring will greatly assist in this selection.

The use of special grade casing has provided additional strength and the large amounts of cement being placed behind the casing assists in a number of ways in effecting a satisfactory shut off.

A slight deviation of the hole at or just above the cementing point may endanger the success of a cementing job by preventing the cement from entirely surrounding the pipe at the vital point. At this point underreaming can be carried out to enlarge the hole for a short distance to ensure sufficient clearance, and where the angle of inclination is known the amount to be cut off can be definitely determined.

Floating equipment of the non-metallic type will offer no difficulty in drilling out, and will definitely relieve the equipment of a large part of the weight whilst the string is being run. An excessive amount of weight will still have to be carried when the string is a long one, and this will make the lowering and raising of the pipe during cementing operations a risky operation. The use of a shoe or collar which discharges the cement in a spiral direction around the pipe can be used to ensure that the cement does not channel.

Speed is an important factor in all cementing operations.

Scraping of the walls of the well will not only enlarge the hole but will also remove the sheath of mud deposited during drilling and assist in reducing contamination of the cement. L. V. W. C.

968. Chemical Treatment of Rotary Drilling Fluids. H. A. Ambrose and A. G. Loomis. *Ind. Eng. Chem.*, 1933, **25**, 1019.—Weighted rotary drilling fluids are discussed from the standpoint of colloid physics, with emphasis on the stability of dispersions of barytes as a function of the p_H value of the dispersion medium. It is shown why a material such as bentonite is superior to chemicals as the protective colloid, and how the stability of the commercial product, Baroid, changes with the p_H value of the suspending medium. The curve obtained for the amount of Baroid remaining in suspension in a 25% dispersion in water as a function of p_H shows two maxima, one on the acid side and one of greater magnitude on the alkaline side, with the isoelectric point at $p_H = 8{\cdot}7$. There is a considerable increase in the stability of the suspension when the p_H is increased from the range 8–10 to the range 10·5–11·5 (*i.e.*, an increase from 25 to practically 100% remaining in suspension in 12 hours). The results are applied to actual drilling practice. W. H. T.

969. Calculating Weight of Drilling Mud. E. J. Maust. *Oil and Gas J.* 10.8.33, **32** (12), 35.—The problem of gas cutting, based upon the association of liquified gas with cuttings, is considered and formulae given which enables the weight reduction due to gas to be calculated. L. V. W. C.

970. Shooting Practices in the Ritz-Canton Field, McPherson County, Kansas. V. D. Bennett. *Petr. Eng.*, Aug., 1933, **4** (12), 22.—Precedent has determined the oil well shooting procedure in the Ritz-Canton Field, Kansas, rather than a proper consideration of the engineering factors involved in the correct use of explosives.

Since highly specialised knowledge and experience is called for in the shooting of an oil well, the many factors which enter into the problem should be considered in detail prior to placing the shot. Such factors as type of explosive, character of formation, quantity of explosive, degree of confinement and type and quantity of tamping should all be considered if the best results are to be obtained. L. V. W. C.

971. East Texas Pumping Conditions and Trends. W. L. Baker. *Petr. Eng.*, July, 1933, **4** (11), 39.—A variety of pumping problems will be encountered in the East Texas Field, which will not be met with in any other field in the world. Problems caused by paraffin, salt water and low pressure will be present, and swampy land and river bottoms will add to the troubles.

Standardisation of equipment is practically impossible, but the new and improved design of equipment should give efficient and satisfactory service. The installation of equipment on concrete foundations has assisted in reducing shut down time. L. V. W. C.

972. Solving Well Pumping Equipment Problems. H. Leeden. *Petr. Eng.*, Aug., 1933, **4** (12), 54.—This article deals with the rating and selection of pumping equipment. A consideration of such variables as depth of pumping, weights of material, counter-balancing, etc., will enable the load ratings to be made. L. V. W. C.

973. Investigation of the Load on a Sucker Rod Joint. E. Kemler and L. W. Vollmer. *Petr. Eng.*, July, 1933, **4** (11), 49.—This article describes some tests that were made on sucker rod joints and discusses the significance of the results. L. V. W. C.

974. Testing Machine for Electrical Oil Well Pumps. Anon. *Petr. World* (L. A.), 1933, **30** (7), 40–1.—A new testing instrument has been designed to aid oil operators in their efforts to reduce pumping costs and to operate above ground equipment at its highest efficiency. This instrument is a set up of watt meters and transformers mounted in a car, and can be used with motors from two to one hundred horsepower capacity. Its use has resulted in the replacement of larger motors by a smaller size in some cases, while it has aided in the attainment of smoother pumping motion and a reduction in power costs in other instances. It has also indicated that a change in rotation of the motion will produce better results under certain circumstances. A description of the instrument and of the method of test is given. G. R. N.

975. Electrical Pumping of Oil Wells. D. K. Weaver. *Petr. World* (L. A.), 1933, **30** (7), 29–30.—Since the beginning of the year the pumping of oil wells in the Santa Fe springs district has been changed over from gas and steam engine pumping drives to electric drives for the following reasons: (1) Even flow of electric power tends to increase oil production at the same number of strokes. (2) "Down" time for repairs and maintenance is minimised. (3) Equipment is neat, compact and quiet in operation. (4) The power of the motor is adapted to meet the exact pumping power requirements of the well and a portable pulling equipment is used for service operations. (5) Hazards of fire and explosion are reduced. (6) Clutch and belt upkeep is practically eliminated. (7) Attendance required at the wells is minimised. (8) Lubrication costs are reduced. (9) Experience shows that rods unscrew and break less often because of the more even and steady motion of the beam. (10) Even motion of the beam means less whipping or spring of the rods in deep holes. (11) Electric drive is not affected by water in the gas lines, low steam pressure, poor mixture in cold weather or too rich mixture in hot weather. (12) Fire risk, loss, and insurance premiums are reduced both for fires and compensation. (13) It is impossible for motor to run away, and menace to life and property from exploding flywheels is eliminated. (14) Salvage value of the equipment is higher than other oilfield power equipments. G. R. N.

976. Selection and Rating of Oil Well Pumping Units. B. Thomas. *Oil Weekly*, 7.8.33, **70** (8), 18.—Improvements in oil well pumping units in the past few years have been mainly in geared units, although refinements in the general design and construction of all types of pumping units and a wider application of alloy steels for shafts and other parts have been prevalent. Pumping units of increased capacity have been introduced to provide for heavier pumping loads.

The methods used by manufacturers for rating their units vary considerably. In any new producing area there is always a difference of opinion among operators as to the size of pumping machinery that will be needed when the wells cease to flow. This difference of opinion is due partly to the uncertainty concerning the actual working capacity of the several makes and types of pumping units. A common method of rating pumping units in terms that can be readily understood and applied is greatly needed.

The author suggests that an A.P.I. rating form for oil well pumping units be adopted, and that pumping units be rated in terms of working horse-power capacity per r.p.m. and working torque capacity. By rating a unit in terms of horsepower per r.p.m., an operator will know the limit to which he can load the unit at any given pumping speed. When the working torque capacity is also given, the crank-pull capacity of the unit for any stroke length can be determined. Knowing the crank-pull capacity, and assuming that the crank-pull on a properly counter-balanced well is equal to the full weight of the oil, the depth from which the unit can pump with any given size of working barrel can be ascertained. L. V. W. C.

977. Stationary Spindle Design for Oil Bath Geared Powers. K. Chickering. *Oil & Gas J.*, 27.7.33, **32** (10), 98.—The essential difference between the stationary spindle type power and other types is that the spindle is an integral part of the base and the main gear and eccentrics or crank rotate as a unit about this spindle.

Several advantages are shown by this type of power. The radial load from the main gear is supported by the base and radial bearings are eliminated. Positive alignment of bearings and gears is possible and there is no possibility of the spindle getting out of alignment.

Compactness and a reduction in the overall height are two of the most desirable features of this unit, and the pull rod connections are close to the foundation.

Both eccentric and crank type powers are available. L. V. W. C.

978. Horse Power Ratings of Gears in Pumping Equipment. W. E. Sykes *Oil Weekly*, **70** (9), 16.—From data collected over a number of years it has been ascertained that precision in determining load ratings is impossible and the employment of complicated formulæ is, therefore, useless.

The number of teeth of a herring bone pinion, where the number lies between 14 and 34, only slightly affects the load-carrying capacity. Although the number of teeth within these limits is not important, it is desirable to choose the number more or less in proportion to the peripheral velocity. Where the number of teeth has been chosen correctly the load-carrying capacity of a herring-bone pinion is in direct proportion to its diameter and face width.

It was concluded, therefore, that the simplest practical method would be to use a tooth factor, which is equal to the load-carrying capacity per inch of diameter per inch of face width.

Formulæ and tables are given based upon the above considerations.

L. V. W. C.

979. Principles of Gaslift. J. Versluys. *J. Inst Petr. Techn.*, 1933, **19**, 687–693.—The principles of gaslift are explained by simple mathematical analysis of the disposition of energy in a pipe set vertically in a tank of liquid, the column of liquid in the pipe being broken by a series of weightless cylinders. G. R. N.

980. Conditions under which Gas and Liquid Mixtures Rise. J. Versluys. *J. Inst. Petr. Techn.*, 1933, **19**, 694–700.—A discussion of the principles limiting the different conditions under which the flow of gas and liquid through a vertical pipe can take place. The principles are exposed as simply as possible, and all unessential complications are omitted. G. R. N.

981. Some Methods in Oilfield Water Analysis. W. A. Macfadyen. *J. Inst. Petr. Techn.*, 1933, **19**, 679–686.—An account of volumetric methods devised to analyse oilfield waters on site with the minimum of laboratory equipment. G. R. N.

982. Wire Line Ties for Bottom Hole Instruments. B. E. Lindsly, L. D. Jones and R. C. Lisk. *Oil & Gas J.*, 17.8.33, **32** (13), 9.—The study of ties for wire lines for bottom hole instruments is one of importance to all engaged in lowering various types of instruments into oil wells.

From this study the authors have concluded that the appearance of the knot or tie is no criterion of its strength, and that the strength of the tie is not necessarily the only quality by which a tie should be evaluated. Ties formed by simple bending are inferior in strength to many other types. The position of the tightest wrap has an important bearing on the location of the rupture, and three wraps round the shackle are better than one. L. V. W. C.

983. Water Separator. Anon. *Oil Weekly*, 21.8.33, **70** (10), 35.—Wells in the Hobbs pool, New Mexico, which have begun to produce water are equipped with oil and water separators made in the shops of the Stanolind Oil and Gas Co. They are so designed that they constitute a continuation of the flow line, and are placed between the well head and the choke.

The amount of oil produced is governed by the size of choke, and the water is taken care of mechanically by a float-controlled valve and is drained off as it is separated.

Four joints of 12½ in. casing are welded to form a continuous string, the end nearest the well being connected with a 4 in. string extending through the head and about two-thirds of the separator. The flow nipple is connected into a 3 in. collar fitted in the upper side of the separator.

A 10 in. nipple at the other end connects the separator to a water reservoir. The assembled separator is placed in a horizontal position with the water outlet end lower than the well end and the water reservoir rests on the ground at right angles to the separator.

The water and oil enter through the 4 in. line extending into the separator, the water separated out flows downward to the reservoir, and the oil out through the choke. A remote controller actuates a diaphragm-valve on the outlet of the water reservoir, and as the water is discharged through the valve it is led through a 2 in. line to the evaporation pond. No heat is required to separate the oil and water. L. V. W. C.

984. Cast Iron Heaters and Heat Exchangers for Treating Oil Emulsions. L. W. Hunter. *Oil & Gas J.*, 17.8.33, **32** (13), 8.—Dehydrating processes for the treatment of emulsions may be divided into four division : mechanical, heating, chemical and electrical.

Heat, which plays a big part in all the processes, is a very successful method of breaking down emulsions by producing coalescence and thus improving the quality of the treated oil. Heat speeds up the settling out of the coalesced water, and it permits the cut oil and the clean oil to be handled more quickly and easily.

A standard heater and heat exchanger has recently been developed for the treatment of emulsions, either independently or in conjunction with any of the other methods.

The heater is composed of sections, and gas burners are so placed that the flames rise between such sections to the draft diverter stack. The gas flow to maintain the desired temperature in the oil under treatment is thermostatically controlled.

The cut oil enters through one of the rear bottom openings and rises in the several sections. Discharge to the settling tank is from the top. A certain water level is maintained in the heater by means of a water drain to cause the cut oil to percolate through a volume of hot water and so obtain the best results.

Heat exchangers are an essential part of practically every economical heat treatment system. The cut oil is made to pass through the inner tube of a cast iron heat exchanger, and the hot oil from the heater goes in counter-flow through the ribbed outer tube to the settling tank, in the meantime giving up heat to the cut oil. This heat exchanger connects the tanks and the heater and thus replaces two separate lines of pipe. L. V. W. C.

985. How Much Will an Oilfield Produce? S. C. Herold. *Petr. World* (*L. A.*), 1933, **30** (6), 23–27.—The author describes a method of computing the content of a pool which depends upon determining edge water position, thickness and porosity of the productive horizons and the percentage recovery. A concrete example of the North Dome of Kettleman Hills, California, and curves of the various characteristics are given. R. E. D.

986. Acid Treatment Generally Beneficial to Seminole Wells. F. Swindell. *Oil Weekly*, 4.9.33, **70** (12), 16.—Although the injection of various types of acid in an attempt to increase production in oil wells has been tried in a more or less haphazard fashion for many years, the technique now followed in most fields is a comparatively recent development. Therefore, any new area which is subjected to this means of increasing production should offer new problems through which the science should find advancement.

The most recent area to receive attention in this respect is the Seminole district in Hughes, Seminole and Pottawatomie Counties, Oklahoma. The first systematic treating campaign was started late in 1931 in the Mount Pleasant field in Michigan. Less than one year later the first well in Seminole district had undergone acid treatment. L. V. W. C.

987. First Approximation of Comparative Ultimate Yields of Oil with Varied Well Spacing. F. E. Wood. *Proc. A.P.I. Prod. Bulletin No.* 211, May, 1933, 14–18.—Pending the development of formulae applying to flow of oil and gas mixtures through porous media and correlation of these formulae with ultimate recovery for various drainage radii of oil wells, an approximation of comparative yields with one well to 40 acres in comparison to four wells to 40 acres is discussed. Certain assumptions have been made in order to determine the probable limits of relative recovery for the two spacings mentioned. It is estimated that in an average oilfield with a sandstone reservoir of continuous porosity and uniform permeability laterally (not necessarily vertically) the ultimate yield of oil per acre from a given 40 acre tract drained by one well will probably vary from some figure over 70% to 100% of the ultimate

oil recovery from the same tract drained by four wells. The production programme for each spacing is limited to maintaining the same pressure differential between the bottom-hole flowing pressure of each well and bottom-hole shut-in pressure. W. W.

988. Economics of Proration. E. H. Griswold. *Proc. A. P. I. Prod.*, Bulletin No. 211, May, 1933, 72–76.—The proration of oil production may be considered as having two phases: (1) the determination of the available market outlet for crude from each pool; and (2) the equitable allocation of this market outlet to the various producers in the pool. The need for some form of proration is put forward and the benefits obtained therefrom outlined. In dealing with proration versus crude price, attention is drawn to the many protests, against the former as supposedly practised, which are directed against the use of proration for the purpose of price stimulation or maintenance. Crude prices are analysed and correlated and the question as to whether or not proration has failed to stabilise the oil industry is considered. In concluding the article the author offers the following recommendations as being pertinent to the proper functioning of a better proration system:—

1. Additional development should be curtailed by crude price or legislative action until supply and demand are balanced.

2. Proration based on potential production and/or per well, should be discarded in favour of more stable and conservative factors such as acreage and sand thickness.

3. A community gathering-line system for each pool should gauge and transport all oil from the wells to an adjacent community tank farm, from which all purchasers would obtain their oil.

4. Nominations should be made obligations to purchase.

5. Nominations should be based on a price-range schedule, each purchaser nominating the quantity he would desire under each of a variety of reasonable prices. The allowable of a pool would then be that quantity and price which would yield the greatest return to the producers collectively, all oil being sold at a common price.

6. Physical-waste limitations should always take precedence over market-demand nominations. W. W.

989. Repressuring the South Eastern Illinois Oilfield. M. H. Flood. *Petr. Eng.*, July, 1933, **4** (11), 36.—After ten years' experimental work in Crawford County the feasibility of repressuring the various sands in this field has become apparent.

At present about 4% of the producing area is being repressured by either air or gas or a combination of both and great possibilities can be expected in increasing production when conditions in the oil industry improve. Some type of rejuvenation will be necessary in the shallow areas and when the occasion demands repressuring will undoubtedly be tried. L. V. W. C.

990. Patents on Drilling Plant.—G. R. Milton. U.S.P. 1,914,380, 20.6.33. Casing head.

J. Ferguson. U.S.P. 1,915,219, 20.6.33. Rotary drilling apparatus for use in oil wells.

N. W. Wickersham and E. F. Raymond. U.S.P. 1,915,771, 27.6.33. Bridging plug expanded by means of fluid pressure.

F. M. Lewis. U.S.P. 1,915,895, 27.6.33. Heater for use in wells.

H. C. Otis. U.S.P. 1,916,070, 27.6.33. Bottom hole choke.

J. G. Grebe. U.S.P. 1,916,122, 27.6.33. Method for treating wells with acid.

J. Littell. U.S.P. 1,917,135, 4.7.33. Fluid operated fishing tool.

W. J. Crites and D. R. Knowlton. U.S.P. 1,917,701, 11.7.33. Well pumping or drilling apparatus of the walking beam type.

E. E. Greve. U.S.P. 1,918,096, 11.7.33. Method and apparatus employed in drilling wells.

E. E. Greve. U.S.P. 1,918,097, 11.7.33. Draw works.

L. F. Baash, E. Burnes and G. B. Garrard. U.S.P. 1,913,442, 18.7.33. Packer for casing heads.

L. F. Baash. U.S.P. 1,918,443, 18.7.33. Tool joint.

G. W. Woods. U.S.P. 1,918,949, 18.7.33. Well strainer.

P. Jones. U.S.P. 1,919,332, 25.7.33. Bore hole surveying device.

N. W. Wickersham. U.S.P. 1,919,350, 25.7.33. Oil well cleaning device.

G. G. Harrington. U.S.P. 1,919,510, 25.7.33. Apparatus for lowering pipes in wells.

H. W. Fletcher. U.S.P. 1,919,546, 25.7.33. Method and apparatus for testing internal diameter of tubes.

H. W. Fletcher. U.S.P. 1,919,547, 25.7.33. Pneumatic swab plunger.

H. W. Fletcher. U.S.P. 1,919,548, 25.7.33. Gas choke for plunger lift devices.

H. J. Hawthorne. U.S.P. 1,919,553, 25.7.33. Detachable blade drag bit.

W. H. Besigk. U.S.P. 1,919,611, 25.7.33. Apparatus for automatically regulating the drill pressure in deep boring plants.

L. P. Kinnear. U.S.P. 1,919,844, 25.7.33. Method of drilling wells.

L. P. Kinnear. U.S.P. 1,919,845, 25.7.33. Well drilling apparatus.

P. H. Mack. U.S.P. 1,919,853, 25.7.33. Well packer.

O. H. Truman. U.S.P. 1,919,917, 25.7.33. Geophysical exploration method.

R. W. Craig. U.S.P. 1,919,931, 25.7.33. Drill stem for flush joint drilling apparatus.

T. H. Stancliff. U.S.P. 1,920,164, 25.7.33. Roller bit.

C. C. Brown. U.S.P. 1,921,115, 8.8.33. Well head equipment.

J. J. Santiago. U.S.P. 1,921,135, 8.8.33. Hydraulically operated underreamer.

F. F. Hill and A. C. Rubel. U.S.P. 1,921,358, 8.8.33. Method for storage of petroleum in natural undergronnd reservoirs.

G. A. Macready. U.S.P. 1,921,472, 8.8.33. Production tester.

L. S. Hamer. U.S.P. 1,921,522, 8.8.33. Well bore feeler.

N. K. Smith and R. K. Hertel. U.S.P. 1,921,547, 8.8.33. Tubing catcher.

E. A. Reed. U.S.P. 1,921,700, 1,921,701, 1,921,702, 8.8.33. Drill bit and cutters.

E. E. Greve. U.S.P. 1,921,747, 8.8.33. Rotary pump.

J. G. Bouslog. U.S.P. 1,922,024, 15.8.33. Tubing head.

J. H. Howard. U.S.P. 1,922,044, 15.8.33. Releasable oil well packer.

J. M. Skinner. U.S.P. 1,922,264, 15.8.33. Displacement pump of the rodless type.

B. S. Minor. U.S.P. 1,922,386, 15.8.33. Locking device for swivelling casing hooks.

H. W. Fletcher. U.S.P. 1,922,427, 15.8.33. Pneumatic swab control apparatus for pumps.

J. A. Herrington. U.S.P. 1,922,436, 15.8.33. Flushing device for well drills.

A. Hollander. U.S.P. 1,922,583, 15.8.33. Tensioning spider for deep well turbines.

J. F. Robinson. U.S.P. 1,922,780, 15.8.33. Cementing apparatus for oil and gas wells.

J. W. Sippin. U.S.P. 1,923,040, 15.8.33. Well pump plunger.

Z. Witkin. U.S.P. 1,923,132, 22.8.33. Safety driving connection for drill strings.

C. E. Reed. U.S.P. 1,923,328, 22.8.33. Antifriction coupling for drill stems.

M. F. Reed. U.S.P. 1,923,395, 22.8.33. Apparatus for maintaining vacuum in oil wells.

A. G. McCoy and B. W. Sunde. U.S.P. 1,923,448, 22.8.33. Whipstock.

J. H. Howard. U.S.P. 1,923,486, 22.8.33. Core drill.

J. H. Howard. U.S.P. 1,923,487 and 1,923,488, 22.8.33. Well drilling bit.

C. E. Weaver. U.S.P. 1,923,694, 22.8.33. Electrical control for rotary drilling.

J. D. Landermick. U.S.P. 1,924,071, 22.8.33. Apparatus for determining the deviation of boreholes.

H. W. How and L. H. Johnson. U.S.P. 1,924,317, 29.8.33. Mechanism for controlling pressure and feed of tools of rotary rigs.

R. S. van Meter. U.S.P. 1,924,424, 29.8.33. Fishing tool.

H. P. Wickersham. U.S.P. 1,924,425, 29.8.33. Blowout preventer.

W. I. Wells. U.S.P. 1,925,015, 1,925,016 and 1,925,017, 29.8.33. Oil well packers. L. V. W. C.

991. Patents on Crude Oil. L. D. Jones. U.S.P. 1,920,565, 1.8.33.—A process for removing oil from oil-contaminated water, in which the latter is contacted with an oil lighter than that to be removed. The light oil may contain an agent capable of reversing the phase of the emulsion.

A. M. Herbsman. U.S.P. 1,921,751, 8.8.33. Petroleum emulsions are broken by admixture with metallic fatty acid soaps such as stearates and oleates of aluminium, calcium or magnesium with or without metallic fatty sulphonates that are incapable of softening water. A special arrangement of jets is provided for mixing the components of the reagent prior to its introduction into the emulsion. W. H. T.

Class 400. Transportation, Storage and Distribution.

992. Modern Equipment in Reconditioning Pipe-Lines. J. D. Cummings. *Pipe Line News*, Aug., 1933, **5** (9), 9.—Some of the practices employed in reconditioning pipe-lines are described, and brief accounts given of the machines and tools which have been developed to facilitate speedy, economical and satisfactory reconditioning jobs. W. W.

993. Accurate Temperature Measurement in Oil Tanks. R. Fussteig. *Erdöl u. Teer*, 1933, **9**, 401–402.—The accurate determination of temperature in oil-tanks is important in estimating the weight of oil contained in the tanks from the volume and the specific gravity, since the latter property varies very greatly with temperature. This is especially the case in tanks heated by steam-coils.

Measurements have shown that the variation in temperature in such tanks is in a vertical direction, the lateral differences being negligible. The temperature is a maximum at the height of the steam-coils, being less at the bottom and about half-way up and increasing near the top, finally falling off somewhat at the surface.

If H is the height of the oil in the tank and t the temperature at any height, the mean temperature is given by the expression :—

$$\frac{\int_0^H t.\,dh}{H}$$

The integration is made with the planimeter. The temperatures may be measured in several ways, *e.g.*, by maximum and minimum thermometers, recording thermometers fixed at various points in the tank, etc. The most practicable way is to lower an insulated vessel fitted with a thermometer and non-return valve into the tank. The vessel is filled with oil at the required level and the vessel withdrawn, the temperature then being read immediately. E. B. E.

994. Earthquake and Fire Protection. G. F. Prussing. *Proc. A.P.I.*, Section 1, May, 1933, 25–32.—A consolidated report of six California Companies. California is a region of earth movements and growth, first recorded in 1769, which almost constantly cause tremors which can be detected only on delicate seismographic instruments and which ever so often cause earthquakes of sufficient magnitude to shatter masonry and similar structures. The average number of seismograph records is about 800 a year, but the average number of real earthquakes in which there is property damage cannot be reduced to an average figure. During the nineteenth century there were at least three severe quakes, and during the first third of this century there have been at least four in which the loss has been considerable. These are San Francisco in 1906, Inglewood in 1920, Santa Barbara in 1925, and Los Angeles Basin in 1933. It speaks well for the designers of oil equipment that in the last mentioned quake, which affected an area thickly covered with large tanks holding millions of brls. of every sort of oil, large and small refineries, casing-head plants, marine terminals, marketing stations and oil-fields having a potential production of several thousand brls. of crude/day —the total property damage was probably less than $1,000,000. There were no fatalities and only one fire on oil property. The total damage done by this fire was limited to three wooden derricks and three small field tanks on an independent lease near Signal Hill.

What is true in building design applies as well to the design of oil facilities. The point of major difference is the fact that good engineering and workmanship has been more consistently displayed in the latter than in the former. Out of the several thousand large steel oil tanks in the Los Angeles Basin, but one actually collapsed in the quake. While much older than most of the tanks in the basin, its design was not inherently different from modern practice. Two other large tanks had single sheets ruptured.

Tanks apparently moved both horizontally and vertically causing strains on pipe connections which—where not compensated for by flexible design—caused failure. The most common of all pipe breaks at tanks was the old-style water draw-off, consisting of an ordinary flange on the tank bottom plus a standard-weight elbow and valve. Close to a dozen failed in the recent earthquake, whereas all the cast-steel water draw-off connections, built according to the design recently adopted as standard by the A.P.I., gave good account of themselves.

During the earthquake the oil in tanks, having roofs with a system of radial rafters carried on steel posts, distorted the tank shells sufficiently to pull the rafters loose from their outer supports. While these roof failures did not affect the safety of the roofs from the standpoint of loss of their

contents, they will be costly to repair. The Institute's committee on tank standards is giving this phenomenon a good deal of study.

Small brick buildings at the refineries suffered typical damage, although very little in comparison with similar commercial buildings, due to better design and workmanship. Where ruptured masonry was found, it was obvious that the mortar was stronger than the brick. Many brick linings of stills and boilers were cracked. Boilers that were buck-stayed horizontally were not seriously damaged, while boilers which lacked this form of support were badly shattered. In the plant referred to, the steam piping was so flexibly supported that it did not rupture.

Column anchor bolts proved valuable in minimising damage in steel structures.

In the oil-fields damage to derricks was largely confined to the snapping of guy lines on wooden derricks and the shearing of anchor bolts on steel-derrick footings. Some crown blocks shifted and some derrick legs were bent, but these were not common. There were some breaks in field-gathering lines and several small field-gathering tanks collapsed. Collapsed casings and tubing pulled apart by the vertical shocks were reported in two instances. The report is illustrated by 14 figures. W. W.

Class 500. Properties and their Determination.

995. Densities of Hydrocarbon Mixtures. E. W. Thiele and W. B. Kay. *Ind. Eng. Chem.*, 1933, **25**, 894.—A review is given of the available methods for computing the densities of hydrocarbon liquids and vapours at any given temperature and pressure. For vapours at low pressures where molecular weight is concerned, mean boiling point affords a rough correlation, but actual molecular weight determinations on the particular type of stock are necessary for accurate correlation with any particular property. For vapours at high pressures, the curves developed by Cope, Lewis and Weber are suitable, but they necessitate a knowledge of the critical pressure and this is not readily calculable. For liquids, a new set of curves is presented based mainly on the work of Jessup. These curves require a knowledge of the density of 60° F. and the viscosity. Preliminary data on the change of volume of petroleum oils on mixing show that contractions of at least 0·25 per cent. may occur. W. H. T.

996. Pressure-Temperature and Low Pressure Total Heat Relationships of Petroleum Fractions. E. G. Ragaty, E. R. McCartney and R. E. Haylett. *Ind. Eng. Chem.*, 1933, **25**, 975.—Vapour pressure charts developed from data of pure compounds may give rise to errors when the " pure-cut " lines are used for estimating dew and boiling lines for petroleum mixtures, since the lines for such mixtures cut across the pure compound lines at various angles depending on the boiling range. A method of identifying the equivalent pure cut of a wide cut fraction has accordingly been developed and data have been analysed to show that the critical point for such a cut constitutes the common point of convergence for the dew lines of all similar wide-cut fractions of equal gravity. This equivalent pure-cut critical point can also be used as a guide for the development of wide-cut boiling lines and partial vaporisation effects. Finally, the equivalent pure cut can be used as a basis for calculating the total heats of low pressure petroleum fraction vapours. W. H. T.

997. Improved Methods for Approximating Critical and Thermal Properties of Petroleum Fractions. K. M. Watson and E. F. Nelson. *Ind. Eng. Chem.*, 1933, **25**, 880.—Two new concepts are introduced for correlation of the physical properties of petroleum. The molal average boiling point is used in all correlations involving the boiling point of the stock and a chart is given for estimating this value from the Engler distillation. Variations in physical properties with change in the character of the stock are expressed quantitatively by means of a characterisation factor. This is defined as the ratio of the cube root of the molal average boiling point (° Rankine) to the specific gravity. The factor ranges from 12·5 for purely paraffinic fractions to 10·0 for highly cracked aromatic stocks. On this basis, methods are given for approximating the molecular weight, critical temperature and pressure, specific heats of liquid and vapour, heat of vaporisation at atmospheric pressure, change of heat of vaporisation with pressure, for stocks of varying characters and boiling ranges. The only experimental data required are the Engler distillation and the specific gravity. These relationships cannot be applied with accuracy to such hydrocarbons as undergo chemical change during analysis. W. H. T.

998. Fractionation of Petroleum into its Constituent Hydrocarbons. E. W. Washburn. *Ind. Eng. Chem.*, 1933, **25**, 891.—The purpose of this paper is to outline the methods employed in investigations dealing with the fractionation of petroleum (Oklahoma Crude) and to summarise the results obtained by the Bureau of Standards. Preliminary distillations were from a semi-commercial still and then from a 15 litre apparatus, the latter being used until individual fractions had been reduced to volumes suitable for glass stills in the laboratory. These stills were of various sizes, fitted with Cottrell boilers and columns of two types—bubble cap and chain packed. These apparatus enabled constant boiling fractions to be obtained, the latter being either (*a*) pure substances, or (*b*) azeotropic mixtures, or (*c*) constant boiling mixtures. Each member of the second group was broken up into its constituents by distillations at different pressures, by controlled chemical treatment or by fractional extraction with SO_2. The mixtures of the third type were resolved by fractional crystallisation, by fractionation under reduced pressure or by continued fractional distillation. A list of hydrocarbons so far identified is given together with details respecting percentage, purity, yield, etc. W. H. T.

999. Vapour Pressure and Boiling Point of Pure Methyl-Acetylene. G. B. Heisig and C. D. Hurd. *J. A. C. S.*, 1933, **55**, 3485–7.—The authors draw attention to the various values for the boiling point of methyl acetylene which are recorded in the literature. They have prepared this gas by: (1) methylation of sodium acetylide with methyl sulphate, and (2) the interaction of propylene bromide and alcoholic sodium hydroxide. The latter method was the better and three samples of crude methyl acetylene prepared in this manner were purified in three different ways, to yield three products of identical vapour pressure/temperature characteristics.

The vapour pressure at any temperature is given by :—

$$\log P_{mm} = 7{\cdot}877 - \frac{1247{\cdot}95}{T}, \text{ from } -79{\cdot}5^\circ \text{ C. to } -23{\cdot}5^\circ \text{ C.}$$

The boiling point is calculated to be −23·1° C. W. E. J. B.

1000. Polymorphism of Paraffins. Yannaquis. *Ann. des Comb. Liq.*, 1933, **8**, 486–489.—Paraffin hydrocarbons crystallise in two forms, one of which is only stable in the region of a few degrees below the fusion point. The author has devised a method of determining the transition points involving heating

the paraffin by a little electric furnace on the stage of a polarising microscope. The method has been applied to various paraffin waxes, and the fractions obtained by precipitation with carbon tetrachloride and by distillation.
E. B. E.

1001. Measurement of Viscosities of Liquids Saturated with Gases at High Pressures. B. H. Sage. *Ind. Eng. Chem. Anal.*, 1933, **5** (4), 261–263.—The apparatus used was a modified viscometer developed by Flowers and Hersey. In principle it consists of a ball at the upper end of a closed liquid-filled tube. For any given ball with the tube held at a constant angle, the travel time of the ball multiplied by the difference between the density of the ball and that of the liquid is a linear function of the absolute viscosity of the liquid, if the rate of movement of the ball is not too great. With the modified instrument which consists of a density cell, saturation cell, and inclined tube with device for holding and releasing the ball, the following conclusions were possible :—

1. The viscometer described may be satisfactorily applied to the study of the effect of dissolved gas upon the viscosity of crude oil at relatively high pressures.
2. The instrument is satisfactory for use at temperatures up to 100° C.
3. A wide range of viscosities can be measured with one ball, and to extend such range greatly only a simple change of ball sizes is needed.
4. Both the ball and the tube must be made with a high degree of accuracy.
5. The density of the liquid must also be measured to arrive at either the kinematic or absolute viscosity. R. E. D.

1002. Molecular Phenomena at the Oil-Water Interface. J. J. Trillat and L. Leprince-Ringuet. *Ann. des Comb. Liq.*, 1933, **8**, 492–494.—The authors outline their researches upon the alteration of oils by heat, ultra violet rays or actual use in an engine, which alteration is followed by noting the change in interfacial tension between the oil and pure water. The du Noüy apparatus is used. It is found that the addition of small concentrations of oleic acid (10^{-6} to 10^{-3}) to a saturated hydrocarbon oil in contact with water, causes a large drop in the value of the interfacial tension. The systematic study of the addition of various bodies—*e.g.*, fatty acids, aliphatic alcohols, etc.—indicates that bodies possessing permanent electric moments are absorbed at the interface, the active group attaching itself to the water—*e.g.*, cyclohexanol gives a strong lowering of the interfacial tension, whilst cyclohexane (no electrical moment) has no effect.

The method is valuable in that minute impurities can be detected easily and quickly—*e.g.*, even after two hours of use in an aero-engine, an oil showed a lowering of the interfacial tension with water, indicating the superiority of this method of test over more difficult chemical methods of investigation. W. E. J. B.

1003. Precision Calorimetry for Gases. W. F. Fulton. *Refiner*, 1933, **12**, 315–320.—Describes the construction and operation of a precision calorimeter similar to the Bureau of Standards Calorimeter used in the determination of the Heat of Formation of Water (Bulletin No. 259 by F. D. Rossini, Jan., 1931), also used in the determination of the Heat of Combustion of Methane and Carbon Monoxide (Research Paper No. 260 by Rossini, Jan., 1931), and following suggestions and precautions of W. P. White in Modern Calorimetry. B. C. A.

1004. Kinetics of Dissociation of Typical Hydrocarbon Vapours. R. N. Pease and J. M. Morton. *J.A.C.S.*, 1933, **55**, 3190–3200.—These authors describe data obtained primarily to shed light upon the activation energies

of the heat decomposition reactions of the four main series of hydrocarbons. Substances studied included *n*-heptane, ethyl benzene, pentene-2 and cyclohexane, whilst some additional information was obtained with benzene, toluene, xylene and ethyl cyclohexane.

Rate measurements were made by both flow and static methods at temperatures around 600° C. The former was supplemented by analysis, and from the results of the work the following conclusions were reached :—

1. The reactions studied appear to be normal first order homogeneous gas reactions.

2. The average energy of activation for paraffin hydrocarbons drops as the series is ascended.

3. A side chain in the benzene nucleus has nearly the same properties as the paraffin of the same number of carbon atoms. The side chain does not appear to be freely mobile on the benzene nucleus.

4. The cyclohexane ring is less stable than the benzene ring, and the former probably first breaks to a smaller cycloparaffin ring (*e.g.* cyclohexane →methyl cyclopentane). Cycloparaffins appear to be more akin to the metameric olefins than to the corresponding benzene compounds.

5. The actual order of stability of the compounds tested, at about 600° C., is *o*-xylene, toluene, benzene, *m*-xylene, ethyl benzene, cyclohexane, pentene-2, ethyl cyclohexane and *n*-heptane.

6. A summary of constants for the rate equation, $\log_{10} k = -\frac{E}{2{\cdot}3RT} + I$, is given, and E varies from 70,000 calories for ethyl benzene to 46,500 calories for *n*-heptane. The value of $\frac{E}{I}$ for any hydrocarbon examined in detail is constant and equal to about 4·7. W. E. J. B.

1005. Combustion of Light Hydrocarbons at Constant Volume. M. Akita. *J. Soc. Chem. Ind. Japan*, 1933, **36**, 436 B.—A mixture of hydrocarbon vapour and air or oxygen, when heated slowly at constant volume, will increase in pressure according to the gas laws until a certain temperature (Critical Inflexion Point) is reached, where a sudden pressure rise occurs, after which the mixture again follows the gas laws over another temperature range. Normal paraffins show sudden increases in pressure at several temperatures, this indicating that combustion proceeds stepwise. These reaction temperatures (C.I.P.) have been determined for the first six members of the paraffin series, and it is apparent that the number of stages in the oxidation reaction is equal to the number of carbon atoms in the molecule. The combustion reaction of a *n*-paraffin is of the same nature as the corresponding reaction of a higher member having the same reaction temperature. The same relations hold for the *n*-primary alcohols, and the reaction temperatures of the latter are approximately the same as those of corresponding *n*-paraffins except for the initial reaction temperatures. It is deduced therefore that the following reactions take place: $C_nH_{2n+2} + O \rightarrow C_nH_{2n+1} + OH \rightarrow C_{n-1}H_{2n} + HCHO$, $HCHO + O_2 \rightarrow CO_2 + H_2O$. The heats of reaction at each stage are always the same whatever the number of carbon atoms in the molecule, and the initial reaction temperature corresponds to the lowest value of spontaneous ignition temperature. The higher the reaction temperature, the lower is the combustion stage and the higher the anti-knock value. It is considered that some simple relation must exist between reaction temperature, spontaneous ignition temperature and the anti-knock value for hydrocarbons of the same homologous series, but that such a relation cannot hold for hydrocarbons belonging to different series such as

exist in motor spirit. Anti-knock agents cause an increase in reaction temperature depending on the amount of the "dope" added to the hydrocarbon. W. H. T.

1006. Evaluating Fuels for Internal Combustion Engines with Mechanical Injection. P. Dumanois. *Ann. des Comb. Liq.*, 1933, **8**, 490–2.—Reference is made to the cetene number system of evaluating the characteristics of oils for use in compression ignition engines. This method, however, necessitates the use of an engine fitted with apparatus for obtaining indicator diagrams at normal and half normal pressures. Previous work of the author, on detonation, leads to the conclusion that the delay period is due to the time necessary for the formation of unstable oxidation products, in amounts sufficient to cause auto-ignition of the charge. Hence it follows that if a gas oil is rated in a spark-ignition engine, *e.g.*, the C.F.R. engine, then the lower the octane number or the higher the heptane number, the better the fuel for compression ignition engines. Since gas oil as such cannot be used direct, a mixture of 15% gas oil and 85% spirit is prepared, which the author finds gives satisfactory engine performance. Actually, the C.F.R. engine at 500 r.p.m. and 150° C. jacket temperature was used, and fifteen samples of gas oils, previously rated for cetene number by Boerlage, were rated as described above, the heptane number of the gas oil being the increase in heptane number of the blending spirit due to the addition of 15% of gas oil. Good correlation is obtained, an approximately linear relationship existing between cetene number and heptane number. A different blending spirit was used and found to give equally good correlation. Hence a method is available for testing gas oils for compression ignition engines which requires no additional apparatus to that used for determining the octane numbers of motor spirits. W. E. J. B.

1007. Frequencies of Fuel Knock Noises. W. H. Paul and A. L. Albert. *Nat. Petr. News*, 9.8.33, **25** (32), 24.—Investigations into the frequencies of knock noises conducted by the authors over a range from 50 up to 10,000 cycles per second, show that these occur over a wide range of frequencies, accompanied by a varying intensity.

Observations were taken on a standard automobile engine of recent design, developing max. power, and using a straight-run gasoline. A microphone followed by a detector-amplifier circuit capable of being tuned for any desired frequency was used for measuring the noise intensity, a milliammeter measuring the output from the final valve.

The noise intensity, measured in decibels, was observed: (*a*) for no fuel knock; (*b*) for a light knock, and (*c*) for a heavy knock. Conclusions are: (*a*) that fuel knock is chiefly above 2000 cycles; (*b*) has a max. intensity in the vicinity of 5000 cycles/second; (*c*) is audible over a range from 1000 up to 10,000 and higher.

Existing sound-measuring instruments, consisting of microphone, amplifier and milliammeter, may have their sensitivity increased by a correctly designed tuned circuit, tuned to some frequency above 3000 cycles per second. D. B. B.

1008. Corrosion Test for Liquid Butane. F. M. Clothier, Jr. *Nat. Petr. News*, 23.8.33, **25** (34), 42.—This test is an adaptation of the corrosion test for gasoline (Copper Strip) A.S.T.M. D.130–30, and is for the purpose of detecting the presence of free sulphur or corrosive sulphur compounds in commercial butane.

The apparatus consists of a bomb which is essentially a piece of heavy walled glass tubing about 10 in. long with the ends closed by packing glands, one of which has a detachable head for cleaning the bomb, etc. The two packing glands are connected by a slit metal shield about which rotates a second slit shield. This arrangement serves the dual purpose of preventing flying glass in case of accident, and also of allowing inspection of the copper strip during a test.

In carrying out an experiment, the bomb is thoroughly cleaned and a freshly-polished copper strip about $\frac{1}{4}$ in. wide and 3 in. long is introduced. Butane is then admitted to the apparatus until the bomb is about half full and the whole is then immersed in a bath at 122° F. for three hours. At the end of this period, the copper strip is removed and compared with a freshly polished strip of copper.

Commercial butane passes the test if not more than extremely slight discolouration of the strip is evident. D. L. S.

1009. Analysis of Hydrocarbon Oils. R. H. Griffith and H. Hollings. *J. Inst. Petr. Techn.*, 1933, **19**, 701–712.—An account of experiments on the isolation of paraffinic and naphthenic hydrocarbons from gas oils. The aniline point-boiling point curves for the isolated paraffins and naphthenes are given and their mutual effect on aniline point is shown. G. R. N.

1010. Entropy and Free Energy Relations among Hydrocarbons. G. S. Parks. *Ind. Eng. Chem.*, 1933, **25**, 887.—Methods for determining the free energy changes in reactions involving the hydrocarbons are given briefly. The work of Research Project 29 of the A.P.I. is reviewed and the entropy and free energy relationships obtained for the four typical classes of hydrocarbons (paraffin, olefine, benzenoid, and polymethylene) are summarised. Examples of the application of these free energy data to hydrocarbon reactions (real and hypothetical) are considered. W. H. T.

1011. Preparation of Mono- and Di-alkylcyclohexanes. F. K. Signaigo and P. L. Cramer. *J. A.C.S.*, 1933, **55**, 3326–3332.—In connection with work on the detonation characteristics of pure hydrocarbons (Lovell, Campbell and Boyd, several papers), a large number of cyclohexane derivatives were prepared in considerable quantity.

The method principally used consisted of the addition of Grignard reagents to cyclohexanones, the tertiary cyclohexanols thus obtained being converted to the cyclohexanes by dehydration and hydrogenation of the olefines. The cyclohexenes were also obtained by this method. Aluminium sulphate was employed for dehydration and the platinum oxide catalyst method of Adams for the subsequent hydrogenation. Most of the dialkylcyclohexanols and dialkylcyclohexanes were mixtures of cis- and trans-isomers; the average boiling-range of the latter was 1·0° C. The starting materials were cyclohexanone and the three methylcyclohexanones, which can all be obtained readily. A few of the cyclohexanes were obtained by reduction of the corresponding alkylbenzenes with hydrogen in the presence of platinum.

Seventy-two compounds in all are described, including 22 alcohols, 22 cyclohexenes and 28 cyclohexanes, 6 of each of the first two groups and 5 of the third being new compounds. Cyclohexyl-cyclohexene and cyclohexyl-cyclohexane are included in the series; together with the mono-alkyl members up to amyl, various di-substituted compounds up to 1, 4-methyl butyl cyclohexane and the 1, 3, 5-trimethyl derivatives.

Yields of alcohols from the Grignard reaction varied from 6% to 90%. The dehydration and hydrogenation reactions gave yields of about 80% each. E. B. E.

1012. Rate of Solution of Methane in Quiescent Liquid Hydrocarbons. R. D. Pomeroy, W. N. Lacey, N. F. Scudder and F. P. Stapp. *Ind. Eng. Chem.*, 1933, **25**, 1014.—An apparatus has been constructed by means of which diffusion constants and solubilities of gases in liquids up to pressures of 30 atm. may be determined. The liquid is placed in a cylindrical brass vessel and the gas admitted until the desired pressure is reached. The pressure is then kept constant by the addition of more gas from time to time to replace that diffused into the liquid. The volume of added gas together with the times corresponding to the additions constitutes the data for the calculation of diffusion constants. The possibilities and limitations of the method have been investigated both theoretically and experimentally. Results obtained with methane dissolving in isopentane are found to be in good agreement with theoretical equations. A consideration of the assumptions involved, together with the consistency of the results indicates that the method is capable of giving fairly reliable values for the true absolute diffusion constant, although the probable error may be as great as 4%. An investigation of the extent to which the diffusion constant may be affected by pressure or by the concentration of methane in solutions up to pressures of 20 atm. did not reveal any effect. W. H. T.

1013. Syntheses in the Olefin, Series IV. The Heptenes. F. J. Soday and C. E. Boord. *J. A. C. S.*, 1933, **55**, 3293–3302.—Seventeen of the twenty-seven possible heptenes have been prepared by the bromo-ether synthesis previously described in several papers by Boord and co-workers. Ten of these are described for the first time. The data are tabulated and compared with previous results in the literature.

The corresponding bromo-ethoxy compounds and dibromo-paraffins are also described, together with four heptanes obtained by hydrogenation of heptenes. E. B. E.

1014. Equilibrium in the System Cyclohexane—Benzene—Hydrogen. R. B. Purdum and R. N. Pease. *J. A. C. S.*, 1933, **55**, 3109–11.—These authors have determined the equilibrium concentrations of the above substances at temperatures between 250 and 275° C. Experimentally, mixtures of cyclohexane, benzene and hydrogen, of known compositions, were passed slowly over a copper catalyst and it was determined if hydrogen was consumed or evolved. The composition was varied until no change in hydrogen volume resulted. Expressing the equilibrium constant as

$$K_p = \frac{P_{C_6H_{12}}}{P_{C_6H_6} \cdot P^3_{H_2}}$$

it was found that the Parks and Huffman equation is reasonably accurate but becomes, by altering the last term, more accurate. The amended Parks and Huffman free energy equation for this reaction is:

$$\Delta F^\circ = -43{,}800 + 18{\cdot}2\,T \ln T - 0{\cdot}008T^2 - 31{\cdot}0T.$$

W. E. J. B.

1015. Oxidation of Some Hydrocarbons. — Estradere. *Ann. des Comb. Liq.*, 1933, **8**, 484–486.—Three hydrocarbons, viz., hexane, cyclohexane and cyclohexene, containing six carbon atoms, have been oxidised in the vapour phase. A mixture of hydrocarbon vapour and oxygen in the molecular ratio of 4 to 1 was passed at a pressure of 1 atmosphere and a rate of 9·25 litres per hour, through a furnace composed of a packed pyrex glass tube. The gaseous products were analysed for O_2, CO and CO_2 and the liquid condensate for

peroxides (by means of potassium iodide). Curves are given showing the percentage composition of the gas against the furnace temperature.

Active oxidation starts at about 330, 340 and 410° C. respectively for hexane, cyclohexane and cyclohexene, appreciable quantities of CO_2 being then formed. Peroxides also appear about this temperature, but disappear at slightly higher temperatures. Explosions occur before the active oxidation sets in and before appreciable quantities of CO_2 and aldehydes have been formed. Cyclisation of a saturated hydrocarbon does not greatly increase the resistance to oxidation, but the introduction of an olefinic bond does markedly increase the resistance. E. B. E.

1016. Occurrence of Higher Fatty Acids in Mineral Oil Distillates. II. E. Holzmann and S. V. Pilat. *Brenn. Chem.*, 1933, **14**, 263–265.—The presence of fatty acids in the naphthenic acids separated from a spindle oil distilled from Boryslaw Crude oil has been observed previously. The acids described were derived from a distillate boiling above 350° C., and from a paraffinous crude oil, whilst A. E. Tschitschibabin has observed that in the case of fractions boiling above 260° C. little or no fatty acids are present, but only cyclic acids.

The methyl esters of the acid mixture were fractionally distilled under a reduced pressure of 12 mm., thereby avoiding the possible decomposition of the acids through heat. Five degree fractions were collected, five distillate fractions and a residue being thereby separated. The fatty acids were regenerated by saponification of the ester with alcoholic alkali. Further separation was effected by the fractional precipitation of the magnesium salts. 1·5–2 gm. of an acid fraction was dissolved in hot methyl alcohol, in such quantity that recrystallisation of the acid did not occur on cooling. The alcoholic solution was treated with about 0·1 gm. of magnesium acetate, also in alcoholic solution, when after some time the magnesium salt crystallised out. After filtering off, the salt was decomposed by hot dilute hydrochloric acid in the presence of petroleum ether. The alcoholic filtrate was neutralised with ammonia and treated again with magnesium acetate.

In this way, from each of the fractions obtained by distillation, there were separated subfractions, amongst which, by means of their melting point, acid value, and the analysis of the barium salts, myristic, palmitic, stearic and arachic acids were identified.

Whilst for the most part the higher fatty acids separated from natural products contain an even number of carbon atoms, acids with an odd number have been observed in several instances. The acids separated in this investigation all contained an even number of carbon atoms, but this regularity may be restricted to the occurrence iof the higher fatty acids, as Tschitschibabin, using much lower petroleum fractions than used herein, has found acids containing an odd number of carbon atoms. B. C. A.

1017. Composition of Naphthenic Acids from Baku Petroleum. B. Tiutiunnikov and I. Pervuhin. *Masloboino Zhirovol Delo*, 1933, No. 3, 8–11. (From *Oil & Colour Trades J.*, 1933, **84**, 519.)—It has been shown by Tschitschibabin that the lower fractions of Caucasian petroleum contain appreciable quantities of fatty acids. Tanaka has isolated palmitic, stearic and myristic acids from Japanese petroleum. The present authors have examined crude naphthenic acids from Baku kerosine and spindle oil distillates. Phenols, hydrocarbons and resins were removed by converting the acids into the ethyl esters and subsequently hydrolysing these. The fraction boiling at 70–210° C. at 2 mm. was then investigated, the following methods being used for separating high molecule weight solid fatty acids: the lead salt-alcohol method of Twitchell, precipitation of lithium salts, Holde's modification of Meinen and

Neuberger's thallium salt method, David's ammonium salt method, and the crystallisation of calcium salts of free fatty acids from acetone. Negative results were obtained in all cases, although 1–2% of added fatty acid could readily be detected in the naphthenic acid mixture.

It is possible, however, that the fatty acids may be present in Baku oil in isomeric forms with melting points so low that the acids are liquid at ordinary temperatures, so that the absence of higher fatty acids is not conclusively proved. E. B. E.

1018. Doctor Test on Natural Gasolines. G. A. Boyd. *Oil & Gas J.*, 13.7.33, **32** (8), 16.—It has been observed that natural gasoline which satisfactorily passes the doctor test prescribed by the N.G.A.A. in January, 1932, sometimes fails to pass when tested by other methods, *e.g.*, method 520.3 prescribed in U.S. Bureau of Mines Technical Paper 323-B. An investigation of the effect of a number of variable factors has been carried out. A sample of mercaptan-free naphtha was used as a base stock and solutions of methyl, *n*-butyl and *n*-heptyl mercaptans of approx. 0·004% sulphur content prepared. The exact mercaptan content was determined and the solutions then diluted as required. The Bureau of Mines test does not specify the size of test tube to be used, and in these experiments tubes of arbitrary size (18 × 150 mm.) were used. The amount of sulphur to be added is also not specified, so the amount adhering to the wet cork after touching lightly in flowers of sulphur and blowing off the excess was used. Solutions of *n*-butyl mercaptan containing 0·00010/·00050% sulphur in increments of 0·00010% were prepared and tested by both methods. It was found that the Bureau of Mines test shows the solution containing 0·00010% sulphur to be sweet and that containing 0·00020% sour, whereas the N.G.A.A. method shows both these samples to be sweet and solutions of higher mercaptan concentration sour. Further work shows that the doctor solution prepared according to the Bureau of Mines method gives greater lead sulphide precipitate than that prepared according to N.G.A.A. method, and that the area of interface also affects sensitivity, the greater the area the lower the sensitivity. It was found that the Bureau of Mines method will detect methyl, butyl and heptyl mercaptans in sulphur concentrations of 0·002, and 0·0002 and 0·00009% respectively. The N.G.A.A. method will detect butyl mercaptans in sulphur concentrations of 0·0003%. With methyl mercaptans at concentrations near the detection threshold, it was found that lead sulphide does not appear at the interface after agitation, but the mercaptans are indicated by a grey opalescence in the doctor solution layer on standing. On long standing the colour disappears and lead sulphide collects on the bottom of the tube.

The results show that very small percentages of mercaptans can be detected by either method of test. R. A. E.

1019. Action of Metals on the Sulphur Compounds in Crude Benzine from Brown Coal : II. Alkali Metals. H. Hofmeier and S. Wisselinck. *Brenn. Chem.*, 1933, **14**, 286–288.—Crude brown coal-benzine containing 2·07% sulphur was treated with potassium, sodium and a liquid potassium-sodium alloy. Marked desulphurisation resulted which however did not proceed to completion on repeated treatment. A proportion of the sulphur compounds were separated in the form of a sludge, insoluble in benzine, alcohol and water.

By several hours heating with the alkali metal alloy in a closed tube to 140° C., 50 to 75% of the sulphur contained in the benzine was removed.

Solutions of ethyl mercaptan diamyl sulphide and thiophenes in sulphur free benzine, made up to a sulphur content of 2–3%, were treated for 40 days at summer temperatures with sodium, reduced silver and finely divided

copper (Naturkupfer). In the case of the mercaptan marked removal of sulphur was effected, but only to the extent of a few per cent. in the cases of diamyl-sulphide and thiophene. Sodium yielded the most pronounced effect on the mercaptan solution, but an excess of the metal did not remove all the mercaptans. Probably the metal surface becomes covered by the reaction product. B. C. A.

1020. Behaviour of Reactive Sulphur in Benzine with Metals. E. Dittrich. *Brenn. Chem.*, 1933, **14**, 283–284.—Recently Hofmeier and Wisselinck have described the desulphurisation of crude benzine from brown coal by various metals. A diminution of the total sulphur content was obtained, and it was demonstrated that resin formers in the benzine delayed the reaction.

The present experiments are supplementary to the preceding, referring not to the total sulphur but only to the so-called reactive sulphur—viz., that reacting with mercury. It is known that metals in the absence of air react exclusively with the reactive sulphur, and under the conditions of H. and W.'s experiments the sulphur compounds were practically unattacked.

Four different benzines obtained by the high pressure hydrogenation of tar or tar oils, were desulphurised with two different copper powders and a silver powder; 100 ml. of benzine were intensively agitated with 1 gm. of metal for 30 minutes, the powder separated by filtration and the active sulphur remaining in the gasoline estimated colorimetrically.

The desulphurising action of the metals employed increased with temperature reaching 100 with silver powder at 50° C. as compared with 20% at summer temperature, other conditions being equal. Desulphurisation is also affected by the metal employed, by the content of active sulphur and by the nature of the benzine. Whilst H. and W. in their experiments ascribed the variation in their results to the presence of gum formers in the benzine, other constituents can influence the reaction. For example, the presence of certain peroxides, always present in tetralin and some other hydrocarbons, prevents the attack of copper and lead by active sulphur, whilst the formation of mercury sulphide may be delayed. On the other hand, alcohols enhance the corrosive action of the active sulphur. The influence of the alcohol is ascribed to a reduction of the peroxide, whereby the sulphur is rendered free, the acid produced favouring the attack. B. C. A.

1021. Determination of Reactive Sulphur in Benzine. E. Dittrich. *Brenn. Chem.*, 1933, **14**, 281–283.—The methods of Hoffert and Claxton, Kiemstedt-Angelsky and Kiemstedt for the estimation of reactive sulphur in benzine are discussed. Results obtained by the latter two methods are compared against those secured by a copper-colorimeter method, using solutions of known sulphur content.

After stating that for rapid estimation colorimetric methods are especially suitable, the errors to which existing methods are subject are indicated and a further method is described.

As for other methods the apparatus consists of a reaction flask (300–500 ml.) provided with ground-in funnel, a wash flask with 100–150 ml. of hot water and the receiver which contains 25–30 ml. ammonia (0·91) with some water.

100 ml. of benzine—for high sulphur content 50 or 25 ml. suffices—is shaken violently with 2–3 ml. of mercury in a small flask until reactive sulphur is absent. Filter through a dry filter, washing out the flask using either the filtrate or non-reactive benzine. Introduce the filter containing the precipitate and excess mercury into the reaction flask; add a piece of aluminium foil (1–2 gm.) and 50–60 ml. conc. hydrochloric acid and heat to boiling. The wash water is simultaneously brought to the boil. After 10–15 mins. the receiver, which should only be moderately warm, is removed

(testing with lead paper whether the wash flask contains any hydrogen sulphide).

From a burette sufficient copper solution is run into the receiver, so that on shaking the precipitate coagulates and a blue colouration is just distinguishable. Fill up to 100 ml., filter through a dry filter, reject the first part of the filtrate, and determine the excess copper in the subsequent runnings by comparison with a known solution.

The copper sulphate solution was prepared by dissolving 9·915 gm. copper in nitric acid, evaporating with sulphuric acid, dissolving in water and making to 1000 ml. 100 ml. of this solution are diluted at the time of the experiment to 1000 ml., so that 1 ml. of solution corresponds to 0·5 mgm. sulphur. For the preparation of the known solution, a measured quantity of this copper solution was mixed with 25 ml. ammonia (0·91) and made up to 100 ml. with water.

With quite small quantities of sulphur (0·5 mgm.) a turbidity is usually produced, rendering an accurate colour comparison impossible. In this case a larger quantity of benzine must be employed or the excess copper estimated by titration.

The estimation requires about 30 minutes, the titration taking 10 minutes longer.

Commenting on the method, it is stated that the use of mercury constitutes a disadvantage but that a substitute has not been found, other metals requiring even more time. B. C. A.

1022. Quantitative Mercaptan Determination with Cupric Chloride Solution. W. A. Schulze and L. V. Chaney. *Nat. Petr. News*, 23.8.33, **25** (34), 37.—Many methods for the determination of mercaptans have been used from time to time, including: (*a*) iodometric method, not applicable in presence of unsaturated hydrocarbons; (*b*) treatment with sodium plumbite with sulphur determination before the after treatment; (*c*) a method based on titration with silver nitrate and ammonium thiocyanate, liable to give high results; (*d*) sodium plumbite and sulphur, and subsequent conversion of the lead sulphide to lead sulphate.

In this new method the mercaptans are oxidised to disulphides by cupric chloride solution, and the cuprous chloride formed is titrated against standard permanganate solution. To determine accurately such low percentages as are found in hydrocarbon distillates, air must be excluded, as this tends to re-oxidise the cuprous salt.

The following reagents and apparatus are required for the test: (1) cupric chloride solution prepared by dissolving 147 grms. copper sulphate and 135 grms. sodium chloride in 718 grms. water; (2) N/10 potassium permanganate solution; (3) distilled water boiled to remove air, and kept at boiling point until required; (4) three 4-oz. bottles A, B and C, flushed thoroughly with an inert, mercaptan and oxygen free gas to remove air.

80 ml. of the gasoline to be tested are measured into bottle A, and 10 ml. of the cupric solution added, the vapour space above the mixture being flushed briefly with the inert gas. (These volumes of reagents leave as little vapour space as is consistent with vigorous shaking.) The bottle is shaken vigorously for 30–45 secs. and allowed to stand for 1 min., when the separated gasoline should be doctor sweet.

During the 1 min. settling, approximately 1 ml. of orthophosphoric acid and 30 ml. boiling distilled water are added to bottles B and C. To B, used as a colour standard, is added 2 ml. of original cupric solution, and then 1 drop of permanganate, and the colour change is noted for reference.

By means of a 2 ml. pipette, flushed with the inert gas, 2 ml. of the copper solution from bottle A is added to bottle C and titrated with the N/10 permanganate to an end point similar to the blank. Then

$$\%\ \text{mercaptan sulphur} = \frac{(\text{ml. N/10 KMnO4}) \times 0{\cdot}003206}{\text{ml. gasoline} \times \text{sp. gr.}}$$

In the case of very low mercaptan contents N/50 permanganate can be used.

To determine the accuracy of the method, solutions of pure mercaptans in naphtha were prepared by weight and then examined. A table is given which shows that the error varies from −7·5% to +1·3%. Good reproducibility is obtained, and with careful manipulation it appears that the volume ratio of naphtha to cupric solution makes little difference to the accuracy.

H_2S is also oxidised by cupric chloride, and must be removed before estimating mercaptans. This can be done satisfactorily by the use of a properly acidified cadmium sulphate solution (140 grms. of the salt and 6.3 ml. conc. H_2SO_4 per litre), which is shaken for several minutes with the gasoline, separation being afterwards effected by either decantation or filtration.

Since dimethyl sulphide is also liable to oxidation, tests were carried out on mixtures of mercaptans and this sulphide, but it was found that no errors were introduced providing the titration was made within a reasonable time, and the first change of colour was taken as the true end point. D. L. S.

1023. Rapid Quantitative Determination of Mercaptans. G. R. Bond. *Ind. Eng. Chem.*, Anal., 1933 **5** (4), 257–260.—The method depends upon the reaction of cupric oleate with mercaptans involving the reduction of the copper to the cuprous form with the production of cuprous mercaptide, organic disulphide and liberation of fatty acid.

$$4RSH + 2Cu(Ol)_2 = 2CuSR + R_2S_2 + 4H(Ol)$$

From this equation it follows that 1 Cu. is equivalent to 2 mercaptan S.

The cupric oleate solution was prepared with kerosine free from oxidation products to contain about 4 grammes of copper per litre. This was standardised and remains fairly permanent if kept in the dark. The method of analysis consists of shaking small added quantities of standard oleate solution to a given volume of gasoline till the end point, a pale green colour, is clearly visible even in the presence of considerable precipitate. This is run against a blank of the same gasoline which has been sweetened with alcoholic caustic and which is titrated to the same depth of colour. Tables are given to show the accuracy of the method to be superior to any others known, and that duplication is satisfactory. Further work is in hand to show the universal applicability of the method to all types of mercaptans.

R. E. D.

1024. Removal of Thiophene from Benzene by Catalytic Hydrogenation. R. N. Pease, W. B. Keighton and W. C. Munro. *Ind. Eng. Chem.*, 1933, **25**, 1012.—A series of catalysts has been tested in the removal of small quantities of thiophene from benzene by hydrogenation. An equimolecular mixture of cobalt sulphide and molybdenum oxide was the most active catalyst of those tested. At a space velocity (hours^{-1}) of 240, 0·5 mol.% of thiophene was completely removed at 325° C. with a $4H_2 : 1C_6H_6$ mixture.

Investigation of the reaction at 200° C. in the presence of the cobalt-sulphide-molybdenum oxide catalyst showed that the rate was little affected by changes in hydrogen or benzene concentrations. The order with respect to thiophene was less than the first, indicating either a nearly saturated

surface layer of thiophene or poisoning catalysts. Cobalt sulphide with chromium oxide and chromium oxide were found to be good catalysts, but metallic cobalt pretreated with hydrogen sulphide was found to be inactive although untreated cobalt and cobalt sulphide were active. W. H. T.

1025. Absorption in the Ultro-Violet by certain Aromatic Hydrocarbons. M. Aubert and T. Gheorghiu. *Ann. des Comb. Liq.*, 1933, **8**, 451–478.—The authors review the work of Marsh and Henri on the emission and absorption of energy by organic bodies in the visible and ultra-violet spectra. The main types of absorption bands found are briefly described for the various hydrocarbons which have been investigated. The present work concerned the absorption spectra of ten aromatic hydrocarbons, which were investigated using a hydrogen lamp as a source of ultra-violet light. The spectra obtained were photographed and the negatives analysed by means of a microphotometer registering device. From the spectrograms thus obtained tables have been prepared which indicate for each hydrocarbon the absorption bands, their position and number, their extent and the wave-length of the light most absorbed. Two classes may be distinguished, firstly those giving discontinuous absorption, comprising benzene, toluene, ethyl-, propyl-, and butyl-benzene, and secondly those giving continuous absorption, viz., diethyl benzene, amyl benzene, mesitylene, pseudocumene and the triethyl benzenes. The two hydrocarbons, butyl benzene and diethyl benzene are really intermediate in character. It is considered that classification is not of immediate utility in this work, but that the identification of the various absorption spectra is of more practical use. W. E. J. B.

1026. Gas Analysis Apparatus. R. Margaria. *J. Sci. Instr.*, 1933, **10**, 242–246.—The following is a modification of the Haldane gas analysis apparatus in which acceleration of absorption is effected. A description of the new gas pipette employed is given, whereby imposed bubbling together with the consequent turbulent movement of the absorption fluid markedly increase the active surface between gaseous and liquid phases and thus increase the speed of the phase transfer. In the mechanism described, the speed of the reaction is increased as all the mass of reagent in the pipette takes part in the reaction. Comparisons of speed of absorption of carbon dioxide and oxygen by Haldane's apparatus and the modified method are given, and show the greater efficiency of the latter. Another curve is given to show that the speed of absorption of oxygen is greatest with a solution made up as follows: Sodium hydrosulphite, 16 gms.; sodium hydroxide, 13·3 gms.; sodium anthraquinone sulphate, 4 gms.; water, 100 gms. The instability of this, however, caused the author to prefer a solution: Triacetyl hydroxyhydroquinone, 20 gm.; caustic potash, 27 gm.; water, 200 gm., which has been found to retain its strength. R. E. D.

1027. General Properties of Fuels and Lubricants. E. Audibert. *Ann. des Comb. Liq.* 1933, **8**, 385–449.—This paper forms part of a course of instruction on the phenomena of catalysis and hydrogenation instituted by the French Society for Research on the Treatment of Fuels.

A résumé is given of the nature and properties of gasolines, benzole and alcohols (including detonation and gumming), and of Diesel fuels and lubricants, the latter section dealing fairly fully with problems of viscosity, oiliness and lubrication theory. E. B. E.

1028. Gum Stability of Gasoline: II. Observed and True Oxygen Bomb Induction Periods. J. W. Ramsay and H. S. Davis. *Ind. Eng. Chem.*, 1933, **25**, 934.—In view of the fact that variations in heating-up periods and

slight variations in the final temperature can both change the value of the induction period, the rate of rise in temperature of the gasoline during the heating-up period of oxygen bomb tests, has been measured for bombs of several types in both oil and water baths. Methods of correction for this lag are given, together with data which showed that after applying the correction, the same true induction period was found with different bombs although the apparent induction periods were quite different. The effective oxidation produced by any fixed period of heating (10 mins.) increases by 2·7 times for each 10° C. This, when shown graphically, enables the oxidation value of a 10 min. interval at any temperature in terms of its equivalent at 100° C. to be determined. The curve can also be used for calculating corrections for heating lag of bombs. It is suggested that either true induction periods only be recorded or that the bomb testing outfit be rigidly standardised. Finally, it is recommended that all bomb results be given in terms of true induction periods. This will necessitate only the determination of the rates of temperature rise of each type of bomb under normal test conditions.

W. H. T.

1029. Properties and Composition of Gasoline Fractions of Representative Japanese Crude Oils, 12. M. Mizuta. *J. Soc. Chem. Ind., Japan*, 1933, **36** (6), 330B.—A description has been given of the general properties and composition of the casing head gasoline produced in the Kinsui oilfield of Tiwan. The fraction boiling to 175° C. consists of 0·21% of unsaturateds, 24·01% of aromatics, 26·11% of naphthenes and 49·67% of paraffins. The distribution of these types of compounds in the benzene, toluene and xylene fractions is the same as in the Shukoko gasoline (*i.e.*, naphthenes increase in the lower fractions and aromatics increase in the higher fractions).

1030. Emulsion Prepared with German Asphalt-Bitumen. A. von Skopnik. *Asphalt und Teer*, 1933, **33**, 557–560.—Although these bitumens are good binders for roads, difficulty has been found in making emulsions with them unless they have been previously blended with other bitumen (*e.g.*, Mexican). The author describes an emulsion made with a German bitumen (from Dollbergen crude). It has the following properties: water content 45%, ash 0·62%, content of dry material (exclusive of ash) 54·4%, insoluble in $CHCl_3$ 3·8%, bitumen content 50·58%. The bitumen has a softening point (K. & S.) 27° and a paraffin content of 5·2%. The latter figure is high (the German Road Constructors' Association specifies 2·5%), but, in spite of this, the emulsion possesses good adhesive qualities and quickly gives up its water, the dry material adhering firmly and permanently to the chips. Comparative road tests were carried out, details being given, and the author concludes that with suitable operating conditions, results are quite satisfactory.

C. C.

1031. Patents on Analysis and Testing. A. Imbarrato. E.P. 395,149, 13.7.33.—A device for giving warning of the presence of inflammable or non-inflammable gas consisting of a combustion chamber enclosing a small flame maintained from a source of gas or oil supply. The chamber is closed at either end with flameproof screens of metal gauze. The bulb of a thermostat is located above the top screen in the chimney of the apparatus. Expansion and contraction of a liquid in the bulb moves a thread of mercury in a capillary tube over electrical contacts, thus making or breaking a circuit arranged to give audible or visible warning.

S. B.

Class 600. Refining and Refineries.

1032. Transition from Shell to Tube Still not yet complete. G. Reid. *Refiner*, 1933, **12**, 335–339.—Constructional activity as will be experienced during the next few years is not for the purpose of expanding already over-built capacity, but because of the necessity of taking advantage of technical development. From the capacity aspect the industry is adequately equipped to cope with increase in demand. Sufficient shell still batteries still exist to process over 1,000,000 brls. of crude daily. As the majority capacity is in the hands of the large concerns, it is believed that replacement will occur during the next few years, and that the new units will be for the most part of the combination crude skimming and cracking still type.

The operation of cracking units continues to become an increasingly important factor in the business. The transition from shell still type cracking units to tube still units is virtually complete. B. C. A.

1033. Low Temperature Carbonisation of Coal in the Presence of Japanese Acid Clay. K. Kobayashi, K. Yamamoto and H. Ishikawa. *J. Soc. Chem. Ind. Japan*, 1933, **36**, 427B.—The object of the investigation was to obtain petroleum hydrocarbons from brown coal by low temperature carbonisation assisted by the catalytic action of acid clay. From the results of preliminary experiments, three coals were selected and subjected to carbonisation alone and in admixture with various percentages of acid clay. The retort consisted of a simple horizontal electrically wound tube fitted with a thermocouple and the usual apparatus for the reception and measurement of the products. It was found that the decomposition temperature of the three samples was about 300° C., but in the presence of the clay, the temperature was reduced to 150° C. It is suggested that this reduction in decomposition temperature may be due to the decomposition of resinous constituents of the coal by the catalytic action of the clay. The coal-clay mixtures yielded oils of lower specific gravity and higher volatility than those obtained by carbonisation of the coal alone, but as the ratio of clay to coal decreased, the specific gravity and yields increased. It was found that the phenolic fractions could not be converted easily into petroleum hydrocarbons by heating in the presence of the acid clay. The oil obtained from the coal-clay mixtures was distilled into two fractions, one boiling below 200° C. and the other above 200° C. The light fraction was a volatile pale coloured oil (sp. gr. ·8215) which represented 62% by volume of the crude oil, the heavy fraction consisting of a dark brown material of specific gravity ·935. The distillates were fractionated, the former at atmospheric pressure and the latter under reduced pressure (50 mm. Hg). Details of the fractionation are given together with certain analytical details of the fractions obtained.
W. H. T.

1034. Distillation of Coal under Very Low Pressures. V. Stone and M. W. Travers. *J.S.C.I.*, 1933, **52**, 686–687.—A simple glass apparatus is described whereby the liquid products obtained by distilling coal, at temperatures up to about 500° C., may be collected and examined.

Distillation is effected at pressures varying between 10^{-2} and 10^{-3} mms. of mercury and evolved products are condensed with liquid air. Vacuum is obtained by means of a mercury diffusion pump, backed by a Hyvac oil pump. The coal examined was Washed Staveley Nuts, which at 350° C. showed about 10% loss in weight when distillation was carried out over six days. Liquids obtained were largely soluble in benzene, any insoluble portion being taken up readily by alcohol.

The results obtained are compared with Bone's benzene extraction of coal under pressure, and it is suggested that decomposition of coal by destructive distillation involves the migration of hydrogen atoms towards the edges of the continuous hexamethylene structure of the coal. Subsequently ethane, ethylene, etc., break away and larger fragments which are tar molecules. Pictorially a representation of this is given, which indicates why intermediate molecular weight compounds are not formed. W. E. J. B.

1035. Principles of Rectification: Part III. G. A. Burrell and N. C. Turner. *Nat. Petr. News*, 31.5.33, **25** (22), 23.—In parts I. and II. methods of calculating sizes of fractionating columns, condensers, and base heaters or reboilers, were discussed. Another accessory to be considered is the heat exchanger, which utilises the sensible heat available in the product leaving the base of the column for the purpose of preheating the feed.

The heat exchanger is usually not capable of cooling the base product to a sufficiently low temperature, nor does it always preheat the column feed to the required extent. It is sometimes even advantageous to vaporise a portion of the charge. However, the use of a preheater in addition to the heat exchanger is generally uneconomic, unless waste heat is available. This is illustrated by the McCabe-Thiele diagram which is produced and fully described.

Although, theoretically, it is only possible to make one sharp separation between groups of components in a single column, yet in the petroleum industry such a high degree of fractionation is not necessary, and it is thus possible to produce gasoline, kerosine and like fractions in a single column. This is accomplished by taking off, in addition to the overhead product, several cuts from intermediate points in the column, these points being determined by the desired boiling range.

It is found that at any given point in the column certain groups of components predominate. Moreover, the cut will contain a greater percentage of components boiling below the desired range than components boiling above the range. The cut is therefore sent to a stripping tower, which it enters from the top, passing from plate to plate to the bottom. At the base a portion of the product is evaporated and sent up through the tower, the vapour re-entering the main column at the same plate from which the side cut was obtained. Calculations relating to the dimensions of the stripping towers, etc., are similar to those described in Parts I. and II.

Flash towers are similar to the portion of an ordinary fractionating column above the feed plate. The charge, which is hot and usually under pressure, is introduced at the base, where the pressure is sufficiently low to permit a portion to evaporate, the vapours passing up the tower. A reflux condenser at the top liquifies a portion of the vapour, which returns to the base as reflux.

For fractionating heavier hydrocarbons such as lube oil fractions, reduced pressure must be used to prevent cracking. This may be effected by the introduction of steam and consequent lowering of the partial pressure, or by the provision of sufficient vacuum to cause the material to boil at the desired temperature. The principles involved in such fractionation do not differ from the other cases considered, but engineering problems of a different kind are introduced.

In vacuum distillation the air and uncondensed gas are pumped from the system usually by means of multi-stage steam ejectors which, though capable of maintaining a relatively high vacuum, do not have a large volumetric capacity. Air leaks must therefore be kept within small volume. The chief source of trouble is around the liquid pump packings, and to

eliminate this the pumps are placed well below the level of the bottom of the towers, so that the liquid head is greater than atmospheric. The column must be of large diameter to cope with the great volume of vapour produced at low pressures.

A diagram of a vacuum unit is included, showing a steam ejector working in conjunction with a barometric condenser. D. L. S.

1036. Principles of Rectification. Part IV. G. A. Burrell and N. C. Turner. *Nat. Petr. News*, 14.6.33, 25 (24), 35.—When considering heat exchange equipment, the surface area needed can be calculated from the formula :—

$$\frac{\text{B.Th.U. per hr. (heat transfer)}}{\text{Mean temperature difference}} \times \text{Heat transfer coefficient} = \text{sq. feet of surface needed.}$$

Data is given for a typical natural gasoline plant and a heat transfer coefficient of 60 B.Th.U. per sq. ft. per hr. per ° F. is quoted as being the value found in practice. The mean temperature difference is usually taken as the logarithmic mean, but when the difference between the greatest and smallest temperature is large, the arithmetic mean can be taken without much error.

A chart for determining logarithmic mean temperature differences is included.

To determine the overall heat transfer coefficient accurately from theoretical considerations alone is impossible, and manufacturers obtain certain practical data and then, with the aid of theoretical considerations, produce the plant to meet the required conditions.

From Newton's equation for heat transfer by conduction it follows that the quantity of heat flowing through a conductor is proportional to the thermal conductivity of the body, to the area and time, and inversely proportional to the thickness of the body.

The coefficient of heat transfer is usually denoted by " h," and its reciprocal, total resistance to the flow of heat, is equal to the sum of the resistances of the liquid or gaseous films as well as the resistance of the metal walls. The resistance of the metal, however, is negligible compared to that of the fluid films in contact with it.

Heat transfer by convection and conduction for turbulent flow of liquids in clean pipes is given by the Nusselt type equation,

$$\frac{hD}{K} = \varphi \frac{DV}{Z} \frac{(CZ)^m}{(K)} \quad \text{where}$$

h=B.Th.U's./hr./sq. ft. of film area/°F. drop between pipe and fluid ; K=Thermal conductivity of stationary fluid, *i.e.*, of film in B.Th.U./hr./sq. ft./°F./ft. of thickness; D=Inside Diameter of pipe in inches ; Z=Viscosity (centipoises) of fluid film relative to water at 60° F. ; C= Specific heat ; V=Mass velocity in lbs./sec./sq. ft. cross sectional area ; φ=a function to be determined. The evaluation of the exponent " m " has been attempted by different experimenters. Many of the factors in this equation cannot be determined easily, *e.g.*, viscosity of fluid film, and values have to be given which allow the value of " h " as determined by the equation to agree with results obtained in practice.

Data is given of a typical heat exchanger problem, and results are calculated using the above equation. Many factors may upset the calculated value for " h," *e.g.*, any roughening of the pipe walls will increase the fluid film thickness, and decrease the coefficient to a great degree.

The foregoing data deals only with liquid to liquid heat exchangers. Only meagre data has been published on the question of film coefficients for condensing steam and condensing petroleum fractions. The work of McAdams in this direction is discussed.

A table is given showing comparisons between various types of commercial exchangers obtainable to-day, and the expenses incurred in operating such plants are calculated.

So far, only conduction and convection of heat have been discussed. The mechanism of the third way of heat transference, radiant heat, is not so well understood. Radiant brick sections are placed in oil heating furnaces and heat is transmitted from this checker work to the pipe coils by radiation. It is found that by using a combination of radiation, conduction and convection, it is possible to reduce the overall size of furnaces. D. L. S.

1037. Hydrogenation of Petroleum. H. S. Garlick. *Ind. Chem.*, 1933, **9**, 226–27.—The writer describes the developments of hydrogenation as applied to petroleum which the Standard Oil Company has effected. He classifies the adaptations as follows: (1) The conversion of heavy high-sulphur asphaltic crude oils and residues into gasoline and distillates, low in sulphur without formation of coke; (2) Conversion of heavy kerosines into oils of excellent burning characteristics; (3) Desulphurisation, colour and gum stabilisation of cracked naphthas without affecting the advantageous properties; (4) Conversion of paraffinic or aromatic gas oils into low sulphur, gum and colour stable gasolines of high anti-knock without production of coke or tar; (5) Manufacture of special aviation safety fuels and effective solvent naphthas; (6) Conversion of low grade lubricating oils to those of competitive quality. R. E. D.

1038. Activity of Nickel Catalysts in the Methane Synthesis. H. Bruckner and G. Jacobus. *Brenn. Chem.*, 1933, **14**, 265–268.—With reference to the preparation of methane from carbon monoxide and hydrogen, the life and activity curves of various nickel catalysts have been determined. These show that the duration of catalytic activity is in the main dependent on and prejudiced by the formation of higher hydrocarbons.

By reason of its adsorptive powers for these hydrocarbons, silica gel is very suitable for the prolongation of catalytic activity.

In addition to the known value of the oxides of aluminium and thorium in promoting catalyst activity, the alkaline earth oxides are also of value in the order: barium, strontium, calcium.

The activity of nickel catalysts is in the highest degree dependent on the method of preparation. Thus the feebly alkaline catalysts, pure nickel, nickel-alkaline earth oxide and nickel-thorium oxide, prepared by reduction of the corresponding hydroxides, are almost completely inactive. On the other hand, a nickel-aluminium oxide catalyst prepared from the hydroxide possesses high activity. The preparation of the latter from an oxide secured by heating the nitrate results in non-activity.

Favourable results are secured in the case of nickel, nickel-alkaline-earth oxides and nickel-thorium oxide by roasting the nitrate, followed by reduction of the oxide or oxides.

The best catalysts are mixtures of 90% nickel and 10% aluminium or thorium oxide. The addition of alkaline-earth oxides, especially barium oxide, yields also a highly active catalyst.

The addition of cobalt reduces the activity of nickel, whilst copper renders it wholly inactive. B. C. A.

1039. Evaluation of the Precipitated Products in the Acid-Refining of Mineral Oils. J. L. Paganini. *Petr. Z.*, 30.8.33, **29** (34), 6–8.—The acid tars removed from acid-washed mineral oils by means of bleaching earths contain sulphonic acids, oil, water, free acids and ash. This article deals with a method which has been applied industrially to evaluate the tar and used earth.

The apparatus used consists of a number of agitators containing acid tars from the first or second acid treatment, each tar being led separately and continuously through a vessel to an oven which is divided into three compartments. The tar is sweated under suitable conditions in the first compartment for the removal of oil, the organic substances are volatilised by ignition in the second compartment, and in the third compartment the residue is burnt to coke, finally producing a white ash. The sweated oil obtained from the first acid treatment can be refined to yield a good lubricating oil.

The acid tar obtained from an oil of viscosity 15° E. at 50° C. yielded about 500 ml. of used oil and 230–250 gm. of coke containing 7% of ash per kgm. of acid tar; 65% of sweated oil is obtained from the first acid-treatment, which can be mixed with the oil from the bleaching-earth and refined to give a good lubricating oil. The marketable final product amounts to 20–35% by weight of the manufactured acid tar. W. S. E. C.

1040. Loss in Knock Rating with Acid Treatment. C. Wirth, E. R. Kanhofer and G. B. Murphy. *Oil & Gas J.*, 31.7.33, **32** (8), 13.—The object of the research was to develop a method to determine the extent to which acid solution loss, polymerisation loss and distillation loss, contribute to the overall loss in octane number when refining cracked gasoline by acid treatment.

The gasolines used were produced in a Dubbs plant by cracking Oklahoma, Kansas and Arkansas topped crudes. The raw gasolines were treated in the laboratory by agitation with acid for 30 mins. at 40° F., neutralization and re-running in a batch still by fire and steam at a maximum still temperature of 350° F. The effect of loss of light hydrocarbons was estimated by distilling off 50% raw gasoline with steam, blending the distillate and bottoms and comparing the octane rating of the blend with that of the raw gasoline. To determine the effect of heavy hydrocarbon loss (due to incomplete removal of gasoline from bottoms necessary to avoid polymer contamination) it was assumed that the loss of heavy hydrocarbons from untreated distillate would produce the same effect as a similar loss from treated distillate. The octane rating of an untreated distillate similar in boiling range to the finished treated gasoline was therefore compared with that of an untreated distillate which had lost only the light hydrocarbons. The difference in octane rating of the untreated and treated gasolines of the same boiling range represents the combined acid solution and polymerisation losses. The results obtained may be summarized :—

Octane No. loss due to	Oklahoma.	Kansas.	Arkansas.
(*a*) Loss of light hydrocarbons ..	1·0	2·0	0
(*b*) Loss of heavy hydrocarbons ..	–1·0	–0·5	0
(*c*) Acid solution and polymerisation	2·5	2·5	1·0
(*d*) Total loss	2·5	4·0	1·0

The acid usage was at the rate of 6 lb. per brl. of distillate. The properties and yields of the various products are tabulated. The loss of light hydrocarbons in laboratory distillation was 3·1/4·0%, so the drop in octane rating due to this factor should be considerably reduced on the plant scale. The effect of each of the contributory factors is seen to vary with the type of stock utilized. R. A. E.

1041. Refining Cracked Gasoline from a High Sulphur Crude Oil. J. C. Morrell, C. Wirth and J. R. Strong. *Oil & Gas J.*, 20.7.33, **32** (9), 12.—In spite of the refining losses and anti-knock depreciation involved, acid treatment still remains the principal commercial method for refining cracked gasolines. The object of the investigation was to find the best conditions for maximum desulphurisation with minimum loss, when treating high sulphur content products. The use of Oregon Basin, Wyoming crude as cracking stock has been limited by its high sulphur content (3·22%) and a sample of this crude was employed in the tests. The crude was cracked in a Dubbs unit to produce maximum high anti-knock gasoline and a Bunker C specification fuel. Mixtures of this crude with low sulphur content crudes available in nearby fields were also examined and results show the advantage of adopting this scheme where possible. The effects of quantity and concentration of acid, temperature and type of treatment were determined for each gasoline. Losses due to acid solution and polymerisation were determined and a complete inspection of each product was made. Sulphur distribution in the 10% fractions of the gasolines was determined and several treatments were made separately on various fractions of the gasolines proportionately based on their sulphur contents. The separately treated fractions were blended and steam distilled to a finished gasoline. Standard laboratory apparatus was employed with a procedure known to give results comparable to plant practice. The various treatments applied, viz.: (1) Simple acid-caustic method; (2) simple acid-plumbite method; (3) split plumbite method; (4) split caustic method; (5) separate treatment of fractions of distillate; (6) re-running and subsequent treating of gasoline, are fully described and the results obtained are tabulated and discussed. The split caustic method involves preliminary treatment with 30°Bé. caustic solution, water washing and drying the oil prior to acid and soda treatment, and decreases the sulphur in the cracked distillate provided it is present at H_2S or mercaptans of low b.pt. The split plumbite method involves preliminary treatment with 30°Bé. plumbite solution, washing and drying prior to acid and plumbite treatment, and reduces the amount of sulphur in the cracked distillate provided it is present as H_2S, free sulphur and mercaptans. Both methods result in a saving of acid and a reduction in loss, as compared with simple acid-caustic treatment for the same final sulphur content. For example, treating distillate from cracked Oregon basin crude having a sulphur content of 0·63%, simple acid-caustic, split caustic and split plumbite treatments when using 14 lb. of 98% acid per brl., gave the following results: sulphur content of finished gasoline 0·25%, 0·16%, and 0·13%; loss 8·9%, 7·9% and 7·5% respectively. With Oregon Basin cracked distillate it was found that reduction of the treatment temperature from 40° F. to 0° F. did not result in a reduction in sulphur content of the final product, but did reduce the treatment losses. The sulphur concentration in the cracked distillate from Oregon Basin crude and from the mixed crudes was found to be highest in the higher boiling fractions, so that treatment of various fractions with appropriate quantities of acid generally shows improved desulphurisation when compared with treatment of the entire distillate.

R. A. E.

1042. Recovery of Sulphur Dioxide as Dilute Sulphuric Acid. R. L. Capson and J. W. Payne. *Ind. Eng. Chem.*, 1933, **25**, 909.—In view of the invariable production of SO_2 during the acid treatment of petroleum fractions, experiments have been carried out which show that it is practically and economically possible to recover SO_2 as dilute sulphuric acid. By bubbling mixtures of SO_2 and air through water containing manganese sulphate as catalyst, 30%

acid may be produced, but the reaction ceases at 40% strength. Using a glass column with a fine porous plate at the bottom, through which the gas is introduced, increased rates of absorption can be obtained. A study has been made of the concentration of catalyst, temperature, gas consumption, rate of gas flow and depth of absorbing solution, as affecting the rate of absorption. In addition, batch and continuous operation have been compared. The rate of absorption per unit volume is greater with a fine porous plate than with a coarse one, and is lower in both small and large packed columns than in the glass column with porous plate bottom. The catalyst is susceptible to poisoning by certain impurities, and this necessitates the testing of the water used in the process and of the various materials of the construction.

W. H. T.

1043. New Lachman System has Novel Features. J. C. Albright. *Refiner*, 1933, **12**, 298–309.—A Winkler-Koch combination skimming and cracking plant at McPherson, Kansas, commencing operation March 1st, 1933, incorporates refining of vapours straight from the cracking units, by the Lachman Zinc Chloride process. Two earlier installations of this process treated pressure distillate after re-running. The present installation is placed directly on the stream of vapours coming from the Winkler-Koch bubble tower, and processes the product while hot and without re-running. The unit consists of two parts, the contacting and fractionating equipment and the zinc chloride storage, reconditioning and settling tanks.

The combined vapour product of cracking and reformed naphthas, leaving the bubble tower, is led to the first tower of a series of three in the Lachman system. This contact tower, 8 ft. in diameter and 55 ft. high, is of ¼-in. tank steel, and contains 14 trays, each fitted with 21 caps. Both tray and caps are of bronze and the column is completely lined throughout the interior, shell and heads with sheet copper ⅛ in. thick, thus obviating corrosion by dilute hydrochloric acid, which attacks ferrous metals. The zinc chloride solution, 50% concentration, is fed to the column beneath the upper three plates and superheated steam is injected to maintain temperature at the inlet value of about 410° F. By supplying superheated exhaust steam, the fluidity of the treating solution is maintained, and the temperature of the vapours leaving the contact tower is raised slightly. The spent treating solution in the bottom of the contact tower is removed once per eight hours, and passed to the recovery unit.

Vapours from the contact tower pass to a second tower, 8 ft. diam. by 37 ft. high, also of ¼-in. steel. This tower is lined with acid-proof tile and is filled with limestone of varying size. Vapour temperature in this tower is approximately that of the inlet to the contact tower. The purpose of the limestone tower is the neutralisation of the acids formed in the contact with zinc chloride and carried over with the pressure distillate vapours. Hydrogen chloride is removed and calcium chloride falls to the base of the column and is drawn away as sludge.

From the limestone tower the vapours pass to the final bubble tower, 9 ft. diam. by 43 ft. high, and containing 12 bubble trays, which serves to fractionate the lighter fractions from the polymers. Anhydrous ammonia is injected into the overhead line near the outlet of the vapours from the tower to effect a further removal of the acids not separated in the limestone tower. The fractionated vapours are led to heat exchangers and condensers.

Pressure on the system varies from 49 lb. on the inlet to the contact tower to 20 lb. on the final bubble tower.

The Lachman gasoline shows 98% recovery of I.B.P. 90° F., F.B.P. 381° F., colour 30 plus, and octane rating 70, from pressure distillate of the same octane rating and I.B.P. 92° F., F.B.P. 384° F. The gasoline after debutanization is plumbite treated to correct slight sourness.

Bottoms from the first tower, containing the sludge and spent zinc chloride, are transferred to the reconditioning system, where zinc chloride is recovered by dilution with water and settling. The sludge bottoms are finally filtered and the cake dumped.

The capacity of the unit is 4000 barrels of pressure distillate per day, and performance does not appear to be adversely affected by variations in operating conditions. B. C. A.

1044. Reforming Naphtha to Improve Octane Number. E. J. Leroi and H. W. Ferguson. *Oil & Gas J.*, 25.5.33, **32** (1), 48.—The effects of a number of operating factors on the yield and properties of reformed naphtha have been investigated. Charging stocks used were (*a*) Straight-run naphtha of 51° A.P.I. gravity distilling between 230° F. and 415° F., octane number 31 in S.30 engine; (*b*) cracked naphtha of 45° A.P.I. gravity distilling between 260° F. and 415° F., octane number 52. The materials were of mixed Texas origin and were cracked in a unit of the tube and tank type.

In the recycle operations cycle oil from the primary tower joins the fresh feed on passing to the accumulator tank, and the final product is naphtha of the desired E.P. In the once-through operations a small amount of cycle oil is cooled and passed to the soaker outlet, which is equipped with a coke drill. The drilling and cooling action is necessary for satisfactory operation at high temperatures. No attempt is made to fractionate the distillate in this type of operation. Eight series of runs were made, three recycling with coil and soaker at varying coil-outlet temperature and varying E.P. of final gasoline, two once-through with coil and soaker, two once-through with coil only at higher coil outlet temperatures, one once-through with coil only at reduced pressure on straight-run stock only.

The relationship between octane number and total distillate yield for recycling and once-through operations for both stocks is shown graphically. To discuss the yield relationships between operations, all distillate quantities were corrected to naphtha of 400° F. E.P. The per cent. degradation of stocks to gas and tar per point improvement in octane number of gasoline is calculated. The main conclusions are: (*a*) decrease in degradation by once-through operation and by recycling to 400° F. E.P. naphtha, as compared with undercutting E.P. on recycling to improve octane number; (*b*) once-through operations were more feasible for 420° F. E.P. naphtha on account of yields; (*c*) degradation by all three methods is about the same on straight-run naphtha, except as in (*a*) and in the case of coil only runs at reduced pressure; (*d*) generally a lower degradation is obtained with straight-run than with cracked stock for the same increase in octane number, partly compensated for by the fact that no additional refining costs are involved with the cracked stock, which has to be treated in any event; (*e*) coil capacity per day for the same octane number gasoline is greatest with once-through coil and soaker operations with existing equipment, but coil only operation at high pressure would be more feasible with new design and would eliminate cost of soaker; (*f*) cracked naphtha gave greater coke formation than straight-run and so reduced the possible length of runs.

Once-through coil and soaker operations presented no difficulty unless coil outlet temperatures exceeded 980° F. Coil only operations require high outlet temperatures to give octane number improvement, and this causes difficulties owing to tube-metal temperatures. The volatility of the

final gasoline for the same octane number is highest when recycling and lowest when using coil only. The whole of the experimental data obtained is summarised in a number of charts and tables. No interpretation of the economic significance of the results is attempted, but the yields and operating data are considered adequate for an economic analysis of any refinery situation. R. A. E.

1045. Laboratory Control Simplifies Dewaxing Problem. L. L. Davis and D. S. Campbell. *Oil & Gas J.*, 25.5.33, **32** (1), 49.—Control methods used in a dewaxing plant are described. Complete laboratory control of pressing stock should include: (1) Viscosity, for determination of filtering rates. A table gives the relationship between pressing temperature, viscosity of pressing stock and filtering rate as reported by a number of Mid-Continent refineries, and shows the wide variations in wax-press capacity obtained due to variations in viscosity and quality of pressing stock. The optimum viscosity can be ascertained for a given plant by trial and viscosity determinations on stream and tank samples provide the necessary control. (2) Distillation, for determination of yield of raw neutral oils. Quality of pressing stock and particularly yield of lubricating oil is determined by the fractionation of the distillate from the crude. For control purposes a U.S. Bureau of Mines vacuum-distillation apparatus, using 200 ml. of oil and an absolute pressure of 40 mm., has been found very satisfactory. Distillation ranges of several of the Mid-Continent pressing stocks referred to previously are shown. (3) Quantity of wax, which is usually only necessary when using new stocks or those which have been stored for long periods. The wax is estimated by chilling a mixture of distillate and natural gasoline in equal parts to −18° F., allowing the mixture to stand for 24 hrs., filtering and washing. The resultant oil will have a pour test from 0/10° F. and the wax will contain less than 1% of oil and moisture. Wax contents of the distillates examined are shown. (4) Crystal structure of the wax, to determine ease of pressing and sweating. For this purpose a Lietz microscope equipped with Nicol prisms is fitted with a camera. The source of illumination is a 108 watt 6 volt lamp. The water-jacketed hot stage is fitted with a hanging-drop microscope slide having a 3 mm. depression. A single drop of the filtered sample is placed in the slide, and distributed over the depression by tilting the slide. A thermometer is inserted in the air space of the stage above the slide and a strip of celluloid containing a hole for the objective lens covers the stage. Thermometers are used to control the rate of cooling. The microscope is adjusted so that the sample is between crossed nicols, and focussed on the sample. Cold water is passed through the jacketed stage till the first crystals appear, and then hot water is passed until a temperature 40° F. higher is reached in the stage. Cool water is then passed at such a rate that the stage temperature decreases at the rate of 1·7° F. per min. until a decrease of 50° F. is obtained. The microscope is then accurately focussed and the plate in the camera exposed. Preliminary cooling and actual photographing of the crystals may be dispensed with for control work when the characteristics of the distillate are known. To show the effect of distillation range of pressing stock on wax crystal structure a sample of Oklahoma pressing stock was distilled under 3 mm. absolute pressure, and the fractions dewaxed, examined for physical properties and microphotographs taken. Various other samples were tested and photographs are shown. In routine control the crystal form of tank and stream samples is reported every morning to the operating department by number, using a range of 1–10 to describe the quality of structure. In unusual cases microphotographs are taken. R. A. E.

1046. Use of Trichlorethylene in Centrifugal Dewaxing of Distillates containing Lubricating Oils. C. F. Pester. *Oil & Gas J.*, 25.5.33, **32** (1), 52.—On account of the marked difference in gravity between trichlorethylene and oil being dewaxed, the special centrifuge designed by Separator-Nobel reverses the normal points of discharge of petrolatum and bright stock, and uses a lower speed of rotation (8/9000 r.p.m.). Tests have been carried out with this centrifuge, primarily to investigate the claim that it was capable of giving large throughputs with stocks of low wax content, with a smaller spread between pour point of finished oil and centrifuging temperature. A number of samples, varying in wax content and in the amount of refining treatment given, were employed in the tests, which also show the effects of changing the percentage dilution with solvent, and the chilling temperature. From the data obtained the following conclusions may be drawn: (1) In general the S.-N. centrifuge will dewax oils which can be handled by usual centrifugal means, showing to advantage on oils of low wax content and undecolorised stocks. (2) Solvent dilutions lower than for processes employing naphtha as diluent can be used. (3) At a given dilution, the yield of dewaxed oil can be increased by taking lower throughputs. (4) For a given throughput and pour point, yields of dewaxed oil increase with increased oil dilution.

Design of equipment for carrying out the process can be similar to that employed for normal dewaxing plant, but the lower dilution and high allowable chilling rate permit the use of smaller chilling drums. Continuous chilling should be possible and would reduce costs by 15%. Trichlorethylene should be heated to about 120° F. pumped through a mixing column with the feed and the mixture cooled to about the pour point. The solution should then flow to the top of the chillers and leave at bottom. No intermediate tank is used between chiller and the centrifuges, which are totally enclosed. Petrolatum is melted in the centrifuge by closed exhaust steam coils. The solvent recovery still should be designed for exhaust steam heating, and the max. temperature to which the solvent is subjected should be 230° F. The final removal of solvent is effected in a tower which only requires entrainment baffles above the point of feed and about 10 bubble cap trays below. Some means of auxiliary heating is required just below the point of entry, and exhaust steam is used at the bottom of the tower as a stripping medium. The still for the petrolatum should consist of a packed tower and a small feed vaporiser. Solvent vapours and steam pass to the bright stock still overhead condenser. The cost of building a suitable plant depends on the wax content of the stock to be handled, since lower dilution and less chilling is required for stocks of low wax content. Estimates of erection and operating cost are given for plants designed to treat stocks containing 2/3% and 20% of wax respectively, assuming continuous chilling. R. A. E.

1047. Lubricating Oils in Contact with Clays. Effect of Time at Elevated Temperatures. V. A. Kalichevsky and J. W. Ramsay. *Ind. Eng. Chem.*, 1933, **25**, 941.—A simple apparatus (stirred autoclave fitted with removable airtight cover, inlet and outlet for steam, nitrogen, etc., and thermometer) has been used for investigating the effect of time and temperature when decolorising oils with clays. Colour usually improves with increase in time of clay treatment, but owing to the complicated character of the reactions involved, a reversion of colour may occur. A simple relationship between the quantity of clay and the equilibrium colour, such as Freundlich's adsorption isotherm, probably does not hold strictly for petroleum oils, although there is often an agreement. As with time, the maximum temperature used has a considerable influence on the colour of the resultant product. In all cases, colours were measured by means of a photo-electric colorimeter.

W. H. T.

1048. Chemical and Mechanical Features of Asphalt Emulsions. R. M. Heine. *Nat. Petr. News*, 26.7.33, **25** (30), 43–46.—The article consists of a brief review of the constitution, application and methods of manufacture of bituminous emulsions. A few tests for the purpose of checking the quality and for the classification of an emulsion are described. H. G.

1049. Burning of Refinery Wastes. V. R. Chadbourne. *Refiner*, 1933, **12**, 310–314.—As large quantities of steam are required for refinery operation, burning under boilers represents the most advantageous method for the disposal of refinery wastes.

The common wastes for disposal are still gases, acid tars, acid and alkaline sludges, neutralised sludges, wax tailings, heavy residues or pitches and coke, together with mixtures of these, mostly in a semi-solid state. Mixtures containing solid matter may be dealt with by means of rotary sludge burners, which are built up to capacities of several thousand pounds of waste per hour, or by hand-fired grates under boilers. Nearly all refinery waste fuels, except coke, can be put in a liquid or gaseous form by heating and by mixing or fluxing with low-grade oils or tars when necessary. The use of combined burners which can feed any one of the three forms of fuel, liquid, gaseous or pulverised, facilitates disposal.

Petroleum coke is best burned in pulverised form, the best results being obtained when 90% passes a 200 mesh screen. Ball mills have proved successful for pulverisation.

Whilst the various sludges present individual problems, all must be kept hot and continually circulated and agitated, in order to preserve consistency and prevent stoppages. Many can be burnt, using mechanically-atomized burners, but some yield better results with steam atomization. Acid tars occasion no great difficulty apart from corrosion. Burners of acid-resisting alloys have been developed. Corrosive action in the combustion unit is limited to certain localities, such as air preheaters. If the exit gas temperatures are maintained at at least 250° F., corrosive action will not be excessive. Acid fuels cause little damage to refractories, and furnaces may have either air-cooled or water walls. Chimneys are usually protected by an acid-proof lining. B. C. A.

1050. Cleaning Refinery and Gasoline Plant Equipment. Anon. *Refiner* 1933, **12**, 340–342.—In exchanger equipment the fouling of the tubes begins on the side of the heavier material being processed, increasing with time until the exchange of heat is appreciably diminished. When the deposit is mineral scale it may be removed by drilling, using a bit slightly smaller than the tube, by the circulation of dilute hydrochloric acid, or by special tools. In the case of carbonaceous sludge and the like, mechanical cleaning or solutions of cleaning chemicals may be employed. B. C. A.

1051. Effect of Corrosive Agents on Admiralty Metal. S. Born and W. L. Nelson. *Nat. Petr. News*, 19.7.33, **25** (29), 27–31.—In view of the importance of the corrosion problem and the extensive application of copper alloys in refining technology, an investigation of the effect of various corrosive agents on Admiralty metal has been undertaken. The alloy chosen had the following composition: 0·99% Sn, 70·56% Cu and 28·47% Zn. The results obtained show that the metal is most actively attacked by ammonia and by HCl. H_2S, in low concentration, lime and caustic soda have little effect, and hard water is not corrosive unless scale is allowed to form. As far as the corrosion of Admiralty metal is concerned, caustic soda is the best neutralising material for acid corrosion. H. G

1052. Mean Temperature Difference and Heat Transfer Coefficient in Liquid Heat Exchangers. A. P. Colburn. *Ind. Eng. Chem.*, 1933, **25**, 873.—It is pointed out that where the overall coefficient of heat transfer, U, varies throughout the heat exchanger, the calculation of heat transfer by use of the logarithmic mean temperature difference may lead to considerable error. For the special case where U is a linear function of temperature, the simple relationship has been derived that the heat transfer rate is equal to the logarithmic mean $U_1\Delta t_1$ and $U_2\Delta t_2$, the subscripts indicating terminal conditions. A series of curves has been developed for this case, which indicates the temperature to be used with the heat transfer coefficient calculated by a logarithmic mean temperature difference. The application of the procedure is illustrated by two detailed examples. W. H. T.

1053. New Form of Insulation for the Introduction of Electrical Connections into High-Pressure Vessels. A. J. Welbergen. *J. Sci. Instr.*, 1933, **10**, 247.—The author describes a satisfactory method of making an insulated joint to withstand high pressures of 3000 atm. It consists of a conical sleeve of Pyrex glass which is melted into a conical hole, bored out of a plug of steel (24% chromium and not more than 0·15% carbon) at a temperature of 900° C. The connection is made through this, and the whole assembly is heated to white heat and slowly cooled off. R. E. D.

1054. Patents on Cracking.—Standard Oil Co. E.P. 394,745, 6.7.33. A liquid phase cracking unit comprising two or more reaction chambers and a pipe system with three-way valves whereby the oil stream can be diverted alternately to any one reaction chamber.

Universal Oil Products Co. E.P. 394,867, 6.7.33. A liquid phase cracking process in which the residual liquid can be withdrawn from the reaction chamber and passed to a separate heating coil and reaction chamber operating at a lower pressure and at a velocity sufficient to prevent objectionable accumulations of coke in the coil. S. B.

Texaco Dev. Corpn. E.P. 396,517, 10.8.33. Condensate oil is subjected to cracking conditions in the liquid phase, separated into liquid and vapour and the latter subjected to vapour phase cracking at a temperature higher than that of the first stage. The cracked vapours from the second phase are withdrawn and fractionated to produce the desired light distillate.

W. E. Warwick. U.S.P. 1,920,331, 1.8.33. High-boiling oil is heated to above 700° F. under pressure and discharged into a reaction chamber where vaporisation takes place. The unvaporised oil is passed through an independent heating zone and back to the chamber at a point remote from that where oil is introduced from the first heating zone.

F. Tinker. U.S.P. 1,920,815, 1.8.33. Crude oil is heated, mixed with hot oil from a cracking operation and the mixture discharged into a separating zone from which residuum is removed. The vapours are partially condensed and the condensate subjected to cracking. The pressure is reduced, the cracked product heated to a higher temperature and then passed to the mixing zone, where it comes into contact with the incoming heated crude oil.

W. M. Cross. U.S.P. 1,920,929, 1.8.33. Oil is subjected to cracking conditions of temperature and pressure by passage through a continuous coil heated by radiant heat. The oil is then passed to a second heating zone subjected to convection heat from combustion gases, where the cracking temperature is less than that of the first zone. The oil is finally passed to another section of the second zone, where its temperature is rapidly reduced by the introduction of cooler oil.

W. M. Cross. U.S.P. 1,920,930, 1.8.33. Cracking apparatus consisting of a heating coil exhausting into an enlarged conversion chamber and through which the oil is circulated continuously. A pressure reduction valve connects the conversion chamber to a still, both being connected to a single condenser.

J. D. Seguy. U.S.P. 1,921,246, 8.8.33. Oil is heated under pressure and passed to a reaction zone from which vapours are passed through a primary and a secondary dephlegmator. A stream of raw oil is passed through the first of these to aid the dephlegmation and to preheat the raw oil, while another stream is preheated by heat exchange with the reflux from the second dephlegmator. Both streams are then combined and introduced together with the reflux condensate to the heating zone.

B. N. Broido. U.S.P. 1,921,602, 8.8.33. A cracking furnace, in which a water screen is used to reduce the temperature of the combustion gases before they come into contact with the cracking tubes.

B. N. Broido. U.S.P. 1,921,603, 8.8.33. Oil to be cracked is heated to the most desirable cracking temperature and maintained so by the addition of sufficient heat to support the reactions taking place. This is effected by control of the temperature of the combustion gases.

W. B. Pennîman. U.S.P. 1,922,322, 15.8.33. A cracking process in which the heat required to maintain cracking temperature is developed within the body of oil undergoing treatment by combustion of the carbon formed as a result of the cracking.

A. Mittasch, G. Stern and E. Galle. U.S.P. 1,922,491, 15.8.33. Cracking of heavy oil is effected in the liquid phase at 300°–450° C. in a space confined by a material selected from the group consisting of free titanium, tantalum and alloys of the latter. The reaction is carried out in contact with a non-metallic anti-carbon forming catalyst selected from the class consisting of selenium, tellurium, oxides of the heavy metals of the third to sixth group of the periodic system and of iron, nickel and cobalt.

A. G. Davis. U.S.P. 1,922,528, 15.8.33. A combined cracking and distillation plant in which uncondensible gas from the distillation stage is returned directly to the fractionating stage and percolated through a pool of the condensate collected in the bottom of the fractionating stage.

A. D. Smith. U.S.P. 1,923,016, 15.8.33. Oil is cracked in the liquid phase and the resulting product separated into residue and vapours. The latter are fractionated and the reflux condensate revaporised and the vapours cracked and dephlegmated in admixture with the products obtained from a second vapour-phase cracking reaction. The heavier fractions from the mixture are vaporised and subjected to a second vapour-phase cracking reaction.

O. G. Kaasa. U.S.P. 1,923,150, 22.8.33. A process for cracking a highly refractory stock. A stream of less refractory stock is first passed through the tube heater until a thin deposit of soft coke is formed on the interior of the tubes. The main stock is then circulated at cracking temperature whereby hard coke is deposited on the previously formed soft coke.

W. W. Lowe and H. N. Lyons. U.S.P. 1,923,271, 22.8.33. Crude oil is topped and then heated to vaporise heavy gasoline, kerosine and gas oil. The vapours are fractionally condensed to yield a kerosine-gas oil mixture from which the kerosine is subsequently removed by distillation. The gas oil is cracked and the cracked vapours passed through the crude oil to carry out the topping.

J. Perl. U.S.P. 1,923,278, 22.8.33. Oil is cracked at high temperature and the highly heated products utilised for indirectly heating and cracking a heavier oil.

O. Behimer. U.S.P. 1,923,526, 22.8.33. Heavy oil mixed with condensate from a previous conversion is heated at high velocity in two stages, one a

heating stage and the other a reaction stage. The high velocity minimises carbon formation. The pressure on the converted oil is reduced and the latter passed through a raw-feed heat exchanger into an enlarged chamber from which vapours are removed. Heavy condensate from these vapours is returned for admixture with the feed.

A. S. Bailey and E. M. Reynolds. U.S.P. 1,924,534, 29.8.33. Hot cracked residue is passed into a surge chamber interposed between the high pressure conversion zone and a reduced pressure distilling zone. The residue is passed from the surge chamber into the latter zone where it is separated into fuel oil, a plurality of gas oils and a naphtha. One of the gas oils is returned to the pressure conversion zone.

E. C. Herthel. U.S.P. 1,924,687, 29.8.33. Means are described for minimising the overheating in cracking coils which occurs near the lateral boundaries of the path of travel of the heating gases over the heating tubes. Orifices are provided adjacent to the inlet ends of each of the heating tubes so that the cross-section of the tubes is restricted at that point. The orifices are smaller near the centre of the path of travel of the heating gases than near the lateral boundaries of said path.

G. Egloff. U.S.P. 1,924,848, 29.8.33. Cracking, with return of reflux condensate to the cracking coil. During operation of the process, the character of the oil charged to the coil is changed (*e.g.*, fuel oil to gas oil to kerosine). With each change of type of oil, the point in the coil to which the reflux condensate is returned is also changed.

W. R. Howard. U.S.P. 1,924,859, 29.8.33. Cracked vapours are passed through a body of heated oil before passing out through the vapour line. The oil may consist of the reflux condensate collected in an inner still in the main distilling apparatus. The reflux is kept separate from the liquid in the main still, but is subjected to the same heat and pressure. W. H. T.

1055. Patents on Hydrogenation.—Processco, Ltd. E.P. 396,065, 17.7.33. Hydrogenation residues are treated with superheated steam at a sufficiently elevated temperature to ensure evolution of free hydrogen and other gases which are subsequently employed in the hydrogenation reaction.

F. S. Woidich. E.P. 396,054, 20.7.33. Coal-oil mixtures are heated under pressure and then passed to a separator in which volatile constituents are removed. The residue is passed to a converter and subjected to destructive hydrogenation for conversion into volatile constituents. The residue from the last operation contains a high percentage of finely divided carbon and is used as a fuel.

M. Pier, M. Wildhagen and W. Schunck. U.S.P. 1,920,886, 1.8.33. A method for controlling the working temperature of hydrogenation. The hydrogen is preheated and then brought into indirect heat exchange with the hot materials undergoing treatment thereby heating it to a temperature approaching reaction temperature. The hydrogen is then further heated to a temperature exceeding that of reaction and then brought into direct heat exchange with the substances being treated.

M. Pier. U.S.P. 1,920,887, 1.8.33. In order to obviate losses of oil due to adsorption by unhydrogenated solid residue, it is proposed to carry out the hydrogenation of solid materials under such conditions that only a little benzine is formed. High boiling oils are removed from the treated solid residue and the latter extracted with an organic solvent which is not a precipitant for asphalt.

M. Pier and W. Rumpf. U.S.P. 1,923,888, 1.8.33. In order to avoid local superheating during the reaction of hydrogen and bituminous materials, the confined pathway through which the mixture travels is heated by a mixture consisting of flame gases diluted with cool gases of combustion. The gas mixture is at least 100° C. higher than the temperature of destructive hydrogenation, but is below 800° C.

M. Pier. U.S.P. 1,921,477, 8.8.33. Hydrogenation in stages, the first being carried out under relatively mild conditions with only partial destructive hydrogenation. The low boiling material is separated and the residue subjected to a second stage of treatment under more rigorous conditions and using catalysts where desirable.

M. Pier. U.S.P. 1,921,478, 8.8.33. Hydrogenation of fluid hydrocarbons at 300°–700° C. and at least 20 atm. pressure in the presence of a catalyst immune to sulphur poisoning. The reaction causes the formation of undesirable high molecular weight substances which are injurious to the catalyst. This formation is prevented by carrying out the reaction in the presence of a high-boiling aromatic solvent (anthracene oil) which continually dissolves the injurious materials.

M. Pier and W. Simon. U.S.P. 1,922,499, 15.8.33. A hydrogenation catalyst consisting of at least three different constituents: one from the class consisting of the oxides of zinc and magnesium and zinc sulphide and the other two being different compounds selected from the class consisting of the oxides and sulphides of nickel and cobalt and the oxides of vanadium and of the metals of the sixth group of the periodic system.

C. Krauch and W. Simon. U.S.P. 1,922,542, 15.8.33. Hydrogenation of middle oil at about 450° C. and 200 atm. in the presence of active charcoal bauxite, etc., for the production of low boiling products containing substantial amounts of unsaturated hydrocarbons. The products thus obtained are then hydrogenated further under the same conditions, but in the presence of catalysts such as cobalt, molybdenum, tungsten, etc.

E. Galle, W. Rosinsky and G. Hofmann. U.S.P. 1,923,571, 22.8.33. Products from the destructive hydrogenation of coal, oils, etc., are converted into low boiling materials by catalytic action at high temperatures. The catalysts employed are of the complex "ansalvo" acid type.

C. Krauch and M. Pier. U.S.P. 1,923,576, 22.8.33. Hydrogenation in the presence of a catalyst consisting of a polyvalent metal and sulphur.

W. H. T.

1056. Patents on Gas. W. G. Laird. U.S.P. 1,920,941, 1.8.33.—Natural gasoline is separated from an absorbing medium by distillation and passage of the resulting vapours through a plurality of condensing zones of decreasing temperature. The condensates from each zone are blended to form a stable gasoline and the residual uncondensed gas passed through the stable product to absorb hydrocarbons suitable as a constituent of the gasoline.

H. C. Weber and W. H. McAdams. U.S.P. 1,923,289, 22.8.33. Pyrolysis of incondensible hydrocarbon gases at 800°–1200° F. and 100–750 lb. per sq. in. Condensible materials are removed and the unconverted gas returned to the heating zone for re-treatment. The time of heating is such that from 7 to 10% of the gas is converted per pass. W. H. T.

1057. Patents on Motor Fuel. Bat. Pet. My. E.P. 395,192, 13.7.33. An anti-knock substance consisting of metal compounds of the condensation products of materials which besides one carbonyl group contain one or more

oxygen containing radicles in the molecule with amines. The most suitable metals are those whose salts form complex ammonium compounds. S. B.

W. C. Holmes & Co. E.P. 395,635, 20.7.33.—Cracked motor fuels are stabilised by treatment with alkali before storage. This is followed by treatment with sulphuric acid (95–96% strength) in two stages, the first of these utilising the acid tar obtained from the second stage. The acid treated spirit is stored for a prolonged period before neutralisation, after which it is subjected to alkali treatment also for a prolonged time.

R. B. Day. U.S.P. 1,920,247, 1.8.33.—Refining of light distillates (straight or cracked) by means of aqueous hydrogen chloride in the presence of a free metal selected from the group consisting of aluminium, manganese, zinc, chromium, iron, cadmium, cobalt, nickel, tin, lead, antimony, bismuth, arsenic, copper and mercury.

R. B. Day. U.S.P. 1,920,248, 1.8.33.—Treatment of light distillates with aqueous hydrogen chloride in the presence of zinc at elevated temperatures above the 1 b.p. of the gasoline. The reaction is carried out under pressure in order to maintain the distillate in the liquid phase.

J. C. Morrell. U.S.P. 1,920,270, 1.8.33.—Liquid phase treatment of gasoline under pressure with hydrogen chloride in the presence of a metal such as zinc, tin and iron.

L. Caldwell. U.S.P. 1,921,116, 8.8.33.—Neutralisation of acid-treated oil with a mineral containing MgO and moistened by aqueous fluid, whereby soluble acid reaction products are formed, such products being removed by washing with water.

C. C. Miller. U.S.P. 1,924,196, 29.8.33.—A method for removing dissolved gaseous hydrocarbons, with a vapour pressure higher than that of butane, from light naphtha. The material is scrubbed with an excess of hydrocarbon gas of about the vapour pressure of butane at substantially atmospheric pressure.

H. H. Cannon. U.S.P. 1,924,911, 29.8.33.—Removal of mercaptans from oil by the addition of finely divided sodium hydroxide and sulphur. The mixture is then passed through a dry powdered mass comprising lead monoxide and sodium hydroxide, the addition of water being avoided.

W. H. T.

1058. Patents on Lubricating Oil and Wax. Standard Oil Dev. Co. E.P. 396,147, 3.8.33.—A gear oil (Visc. Say. at 100° F.–above 1000 secs.) is described, which comprises a major proportion of a heavy hydrocarbon oil (Visc. Say. at 210° F.–above 95 secs.) and a minor proportion (2·5%) of a heavy unctuous material. The latter comprises a condensation product prepared from aliphatic hydrocarbons (mean mol. wt. at least 170 and C : H ratio 100 : 13·5–15). A metallic soap may also be incorporated in the mixture.

J. Y. Johnson. E.P. 397,169, 14.8.33.—The separation of wax from oil-wax mixtures by the addition (0·05 to 40%) of a condensation product of paraffin hydrocarbons (mol. wt. greater than 300) or oxygen derivatives thereof. The mixture is cooled and waxy material precipitated and removed in a normal manner.

H. N. Lyons. U.S.P. 1,920,922, 1.8.33.—Removal of wax from waxy distillates which contain amorphous wax or inhibitors of crystallisation. The oil-wax mixture is mixed with clay and heated to effect removal of water vapour. The oil-clay mixture is then cooled and passed to a chamber in which wax and clay are precipitated by a mechanical "thickening operation."

W. H. Bahlke. U.S.P. 1,921,860, 8.8.33. Production of high melting-point waxes from crude scale wax, etc., by complete vaporisation with steam followed by partial cooling of the vapours to condense therefrom a wax having the desired characteristics. Vaporisation is effected under non-cracking conditions. W. H. T.

1059. Patents on Fuel Oil. F. Krupp Ger. A.-G. E.P. 395,601, 20.7.33.—A method and apparatus whereby a solid-injection compression ignition engine can be run on a long delay fuel, such as tar oil, a precharge of easily ignitable gas oil being injected into the cylinder before the tar oil. Two fuel pumps are used, one for each fuel, each delivering to the same spray valve. At the end of each injection of the driving fuel (tar oil), a charge of the igniting fuel (gas oil) is delivered to the atomiser from which it displaces any residual tar oil and is then trapped ready for the next stroke.

"Laga" Soc. (Spain). E.P. 395,821, 27.7.33.—A method and apparatus whereby a heavy fuel (*e.g.*, gas oil) may be used satisfactorily in a spark ignition combustion engine. The fuel is atomised, mixed with the requisite air for combustion and then vaporised in an exhaust-heated vaporiser. The heated mixture is subsequently cooled before admission to the engine cylinder so that the volumetric efficiency is unimpaired. G. B. M.

J. E. Southcombe and Germ Lubricants, Ltd. E.P. 396,427, 2.1.33.—A fuel is described which consists of a light Diesel oil containing between 1 and 2% of an organic acid of high molecular weight (*e.g.*, oleic acid). W. H. T.

1060. Patents on Special Products.—Standard Oil Dev. Co. E.P. 394,977, 4.7.33. Petroleum insecticides consisting of naphtha solutions of toxic plant principles such as pyrethrum, derris, etc., have been found to be more toxic if the petroleum fraction has an aromatic content (including unsaturates) exceeding 15% and a boiling range of 350° to 600° F. It is, therefore, proposed to use, in place of refined kerosine, the extract obtained by treating kerosine with liquid sulphur dioxide, phenol and similar refining agents.

Henkel et Cie. E.P. 395,198, 13.7.33.—Production of the higher aliphatic alcohols based on the catalytic hydrogenation of organic carboxylic acid—inorganic oxygen acid mixed anhydrides or mixtures of such compounds such as aceto-boric acid anhydride or boro-stearic acid anhydride and similar compounds.

Bat. Pet. Mij. E.P. 395,202, 13.7.33. Synthetic alcohols free from obnoxious odour are obtained by dehydrating the alkyl sulphuric acid-water-polymer mixture by means of such siccatives as anhydrous copper sulphate, lime, calcium chloride, or by a separate azeotropical distillation with the aid of an auxiliary liquid such as toluene, xylol, ethylene chloride or a suitable benzine fraction. Removal of the water from the above mixture allows the separation of the alcohol and odiferous polymer to be effected by fractional distillation. S. B.

Du Pont de Nemours. E.P. 396,064, 17.7.33. An insecticide and fumigant comprising a fluosilicate of an aliphatic or heterocyclic amine and a suitable inert liquid diluent (*e.g.*, sulphonated oxidised petroleum oil).

H. Dreyfus. E.P. 396,107, 24.7.33. Hydration of olefines by water or water vapour at 200° C. in the presence of an acid metallic chloride which is at least as electro-positive as nickel and possessing marked affinity for water (*e.g.*, $ZnCl_2$).

H. Dreyfus. E.P. 397,161, 3.8.33. Manufacture of oxygenated organic compounds by treatment of an olefine (containing not more than five carbon atoms in the molecule) with free oxygen in the presence of water or water vapour at super-atmospheric pressure and in contact with catalysts or oxygen carriers at 200°–600° C.

H. Dreyfus. E.P. 397,187, 21.8.33. Olefines at elevated temperatures and pressures are absorbed in dilute aqueous solutions of relatively strong acids (*e.g.*, phosphoric acid). The absorption product is subsequently hydrolysed by the addition of water or water vapour. W. H. T.

1061. Patents on Refinery Plant.—C. R. Burch and F. R. Preece. E.P. 396,205, 3.8.33. A method for preventing the condensation of vapours in vacuum pumps used for distillation purposes. Means are provided whereby the condensate may be decomposed by heating into solid and non-condensible gaseous materials.

K. Jagschitz. U.S.P. 1,924,281, 29.8.33. A sealing liquid for gasholders consisting of a mixture of coal tar fractions (b.p. 250°–450° C., sp. gr. 1·1, visc. at 50° C., 1·8–3·5° E.) capable of withstanding a temperature of about 30° C. without precipitation. The liquid should be free from dust, pitch, naphthalene, anthracene and phenols.

E. J. Shaeffer, G. W. Watts, E. P. Brown and R. E. Wilson. U.S.P. 1,924,520, 29.8.33. Hot products from a pressure conversion system are discharged into a chamber in which the pressure is below that of the conversion. Vapours are removed and the residue passed to a second chamber, where further vaporisation is effected by contacting with an inert gas.

V. Voorhees. U.S.P. 1,921,850, 8.8.33. Distillation apparatus for handling high boiling oils. Thin film evaporation is used together with vacuum and open steam injection.

C. D. Gard. U.S.P. 1,924,602, 29.8.33. A vertical still operating with open steam and provided with internal heating coils for directing convection currents along certain paths within the still.

B. J. Heid. U.S.P. 1,924,855, 29.8.33. Apparatus for the vapour-phase treatment of hydrocarbons with aqueous reagents. Vapours are passed upwardly through one zone in contact with an acid reagent and then through a second in the presence of a neutralising agent.

A. E. Pew. U.S.P. 1,924,879, 29.8.33. A distillation system employing mercury as the heating medium.

C. F. Tears. U.S.P. 1,925,013, 29.8.33. A four-product continuous topping still adapted to produce gasoline, blending naphtha, kerosine and bottoms. Two towers are provided, the middle cut from the first being refractionated in the second, and the residue from the first being used as reboiling medium in the second. W. H. T.

Class 700. Utilisation.

1062. Gas Conditioning. L. W. Tuttle. *J. Western Soc. Eng.*, 1933, **38**, 142–153.—Manufactured gases such as coke oven gas and carburetted water gas, when distributed are usually saturated with water vapour: condensible oils are also present in these gases. These impurities are regarded as a "necessary evil" and cause very little trouble. Since natural gas has been substituted for these manufactured gases, serious troubles in distributing systems have developed. Natural gas distributing systems readily dry out

with subsequent leakage, dust troubles and inaccurate meter registration. To overcome these disadvantages natural gas is conditioned by oil fogging and humidification. Experiments were carried out with the hot fogger and the atomising fogger, and eventually a modified form of the latter was adopted. This unit consists of a steel tank, at the bottom of which are located eight atomising nozzles, so arranged that the discharge from the nozzles causes a centrifugal whirl of gas and fog inside the tank. The outlet of the fogger is at the top, and as a result only the finer fog particles that have resisted the action of centrifugal force and gravity leave the fogger. Oil is stored in an annular space around the fogger tank or in a separate tank. The oil is maintained at a constant level in the fogger tank. The unit is installed in parallel with the district gas governor, and high pressure gas is by-passed around the governor to supply the atomising nozzles. A unit will fog about 100 million cu. ft. of natural gas per hour at a rate of 2·5 galls. per million cu. ft. Each nozzle will atomise approximately 0·5 galls. oil per day, and the gas used per nozzle is 800 cu. ft. per hr. The operating pressure is 3–5 lb. Owing to the variation of velocity of gas in the distributing system due to variable consumption, it was necessary to equip the foggers with automatic control. The oil used to produce fog must have a low pour point, a low surface tension (or viscosity), a low vapour pressure and a low degree of unsaturation. The humidification of natural gas is carried out by injecting steam, the amount of which is regulated by an automatic unit, into the distributing main. The gas is humidified to 100% saturation in this way. G. R. N.

1063. Fuels for Gasoline Pressure Appliances. R. N. St. John and R. Grubb. *Oil & Gas J.*, 29.6.33, **32** (6), 16.—It is estimated that the sale of gasoline for gasoline pressure appliances now amounts to 500,000 gal. per day. In these appliances liquid gasoline is fed from the fuel tank under a pressure of 5/20 lb. through a hot vaporising tube, where it is gasified.

The gas issues through a small orifice into a venturi tube where air is admitted and mixed with the gas and the mixture is fed to the burners. Combustion is clean, smokeless and practically odourless, and the flame can be easily and accurately regulated. About 75% of the troubles encountered with such appliances were thought to be due to the use of unsuitable gasolines, so in 1929 several of the leading manufacturers organised United Laboratories for the purpose of testing gasolines and recommending to users the particular brands which are found most suitable. Samples are collected by travellers, analysed in the laboratory, and lists of approved gasolines are published every 90 days, subject to revision every 30 days. The tests applied are copper dish gum, corrosion, distillation, acidity, doctor, colour and Voorhees and Eisinger oxygen gum. The appliances will operate on fuels having distillation ranges between 85/437° F. The most recent models light and operate for the first 60/80 secs. on a starting mixture of atomized fuel and air, so that fuel volatility and atmospheric temperature affect starting performance. Probably the ideal distillation range for summer use is 115/350° F., but some customers in northern states prefer a more volatile gasoline having an I.B.P. of approximately 110° F. and an E.P. of 265/300° F.

Preformed gums and gums which form during vaporisation remain in the generator, dry out and accumulate in the form of carbon, which gradually clogs the generator and interferes with the flow of vaporised fuel to the burner by lodging in the outlet orifice. If these deposits consist of heavy oily gums, or gums which dry and leave powdery soft carbon formations, they are difficult to remove with the aid of the cleaning needles provided.

Soft carbon is often due to the presence of corrosive sulphur compounds in the gasoline. The gum content of the gasoline at the time of use should be less than 10 m.g. per 100 ml. (copper dish method). Gasolines which are not gum stable are liable not only to increase generator deposits, but also to give rise to objectionable odours due to formation of aldehydes by oxidation, and to cause deposits in the air-gas mixing chamber.

In United laboratories, gasolines under test are given a value of 100, and points deducted on a scale which is shown according to the results obtained by each of the seven tests enumerated. Final grades of 75/85 indicate acceptable fuels, 90/95 good fuels which can be recommended for continuous service and 98/100 exceptionally clean, stable fuels which are especially desirable as they can be used for long periods without interruption of service or interference with the perfect operation of the appliance. R. A. E.

1064. Exhaust Silencing and Engine Efficiency. J. C. Morrison. *J. Inst. Aut. E.*, Aug., 1933, 8–45.—In this paper the author has gone very fully into the above question, as he realises that the small amount of data available on the subject of variation of pressures and the nature of the sound to be suppressed has been a great hindrance to the solution of the matter. The indicator used, which is fully illustrated and described, enabled exhaust pressure diagrams to be accurately made at each 10° of crank angle up to 4000 exhaust strokes per minute. Roughly the indicator consists of a rotor with flat face and hole communicating with the exhaust pipe, which runs against a stationary face-plate having 18 holes and connecting to a manometer. The rotor runs at half engine speed, so that by turning the face-plate three times through 5° pressures can be plotted for every 10° through the whole cycle of operations. The apparatus was checked by running it with an electric motor and supplying air from a compressed air reservoir, and was found to give very accurate results up to 8000 r.p.m. on a four-stroke engine.

To obtain data pertaining to most usual conditions, pressure curves were made using a large number of silencers with various lengths of pipe, fishtails, etc., complete details of which are given in the article together with their effect on power output. Exhaustive experiments were then carried out to determine the nature of the sound of the exhaust note under varying conditions. From all the data thus obtained the author endeavours to lay down general principles of exhaust pipe design which will conform most nearly to all the desired qualities. C. H. S.

1065. Experiments with a Supercharged Single-Cylinder High-Speed Petrol Engine. G. F. Mucklow. *Proc. Inst. Mech. E.*, 1932, **123**, 373-478.—The paper deals with a series of experiments carried out at the University of Manchester on two different types of aero-engine cylinder. The object of the work was to examine the effects of increased induction pressure, at a range of compression ratios, on such variables as power output, heat losses, and fuel consumption. Two sets of trials were run, the engine speed being 1600 r.p.m. in each. In the first set a Napier two-valve all-steel cylinder was used, and in the second a Rolls-Royce four-valve cylinder of composite construction, with aluminium alloy head and wet liner.

Trials were run at compression ratios of 3·5, 4·0, and 4·5/1 with pure petrol, and at 4·0, 5·0, 5·5, 6·0, 6·5 and 7·0/1 using pure benzole as fuel. At each compression ratio "mixture loops" were obtained at a range of supercharge pressures, the complete mixture range being explored as far as possible in each case. Measurements were made of power output, fuel and air consumption, maximum pressure and heat flow to jackets and to exhaust. The highest induction pressure investigated was approximately 17 lb./sq. in.

above atmosphere, the maximum brake mean effective pressure being approximately 285 lb./sq. in.

The results of the investigation are presented in the following manner. In the first place, typical "mixture loop" curves of power, consumption, heat losses, etc., are given for a range of induction pressures at different compression ratios, the curves being plotted to a base of air-fuel ratio. From these the performance of the cylinders at two chosen mixture strengths is abstracted, tables and curves being arranged to show, at each compression ratio, the effects of increased induction pressure at maximum power and at the mixture strength giving 98% full power.

In the third section, the data are considered, having in view the choice of suitable compression ratios to meet selected conditions of induction pressure and power output. An appendix is included in which the data under consideration are compared with results obtained by Mr. H. R. Ricardo on a sleeve-valve unit under similar conditions, these results being quoted by the kind permission of Mr. Ricardo. W. W.

1066. Absorption Spectra of Gaseous Charges in a Gasoline Engine. L. Withrow and G. M. Rassweiler. *Ind. Eng. Chem.*, 1933, **25**, 923.—An apparatus is described by means of which photographs are taken of absorption spectra of the gases within an I.C. engine running under its own power. Reproductions of some of these photographs are given, the spectra being taken under various engine conditions and with several different fuels. The absorption spectra show that under some engine conditions, chemical changes occur in the fuel-air mixture prior to firing. These changes are greater in degree or different in nature in knocking than in non-knocking combustion. The evidence supports the theory that knock is due to spontaneous ignition ahead of the normal flame fronts. The additional evidence thus adduced adds to the conclusion that the observed weakening of CH and C_2 bonds in the knocking zone when an engine knocks is due to the disappearance of a large portion of the original hydrocarbons before the arrival of the flames with the formation of compounds which do not form CH or C_2 radicals when they inflame. W. H. T.

1067. Railway Traction in Relation to the Oil Industry. G. M. Barratt. *J. Inst. Petr. Techn.*, 1933, **19**, 725–732.—A précis of a paper, read before the Students' Section, London which discusses the advantages and disadvantages of gasoline and oil engines in relation to railway traction. G. R. N.

1068. Performance of High-Speed Diesel Engines for Road Transport as Affected by the Nature of the Fuel. J. G. Withers. *J. Inst. Petr. Techn.*, 1933, **19**, 713–724.—A précis of a paper, read before the Students' Section, London, which deals with the examination of various characteristics of high-speed Diesel engines. G. R. N.

1069. High Power Sulzer Diesel Locomotives. Anon. *Sulzer Tech. Rev.*, No. 1, 1933, 1–9.—This article shows that it is possible to manufacture Diesel locomotives capable of performing duties now carried out by the largest steam locomotives. Great strides have been made during the last five or six years and the number of Diesel locomotives in use is very rapidly increasing. Illustrations of several of these large units are given and the advantages of the system are fully dealt with. Graphs are also given showing the performance of Diesel locomotives up to 4000 b.h.p. with different weight trains and for different speeds and gradients. It is claimed that express train traffic over great distances is work for which the Diesel locomotive could be adopted

with particular advantage since fuel consumption is responsible for a greater percentage of total working costs in such service than in any other.

C. H. S.

1070. Piston Temperatures in a Solid-Injection Oil Engine. G. F. Mucklow. *Proc. Inst. Mech. E.*, 1932, **123**, 349–372.—The experiments under consideration were carried out in the engineering laboratory of the University of Manchester, the engine used for the trials being a Crossley solid-injection heavy-oil engine of 66 b.h.p. The object of the experiments was to measure the temperature of the piston at a number of points distributed over the crown and walls under a variety of running conditions. The piston, which is of the slipper type, was fitted with fourteen thermocouples, four of these being situated in the crown, three at the junction of the crown and walls, three immediately below the first set of rings, and the remainder in the skirt of the piston.

Four series of trials were run. During the first series the piston temperatures were recorded with the engine running steadily at a number of different loads, ranging from no load to full power. Measurements were also made at each load of the power developed, the fuel consumption, the heat flow to the jackets and to exhaust, and the exhaust temperature. The second series of tests consisted of the plotting of "warming-up" curves. In these the temperatures of the different points in the piston were noted at a large number of equal time intervals over a period immediately following a sudden change of load on the engine. During the third series of trials, the temperature of the cylinder jacket water was varied, and the effect produced on the piston temperatures was recorded. Measurements were also made of the fuel consumption with different jacket temperatures.

The fourth series of trials was made in order to note the effect of allowing the free circulation of air to the under side of the piston crown. Normally, a circular steel plate is fixed across the inside of the piston, which entirely seals the space under the piston crown from the atmosphere. During the first three series of trials this diaphragm plate was in position. For the fourth series the plate was removed, thus allowing air to circulate under the piston crown. Measurements were then made of the piston temperatures and the fuel consumption, with the engine running steadily at a number of loads, ranging from no load to full power.

W. W.

1071. Farm Alcohol as Motor Fuel. Anon. *Oil, Paint and Drug Reporter*, 12.6.33, **123** (24), 43; 17.7.33, **124** (3), 38; 24.7.33, **124** (4), 28D; 31.7.33, **124** (5), 36.—A full report of Prof. G. G. Brown's paper on "Agricultural Alcohol in American Motor Fuels," read on May 18th at the Tulsa meeting of the American Petroluem Institute. The paper discusses the above subject under the following headings: (1) Motor fuel as affected by alcohol; (2) Power output; (3) Efficiency or mileage; (4) Anti-knock value; (5) Effect of alcohol on volatility of gasoline blends; (6) Effect of alcohol blends on lubrication and mechanical parts of engine; (7) Effect of alcohol blends on fuel tanks and fuel lines; (8) Effect of water or the effect of alcohol on fuel stability; (9) Experience of foreign countries; (10) Cost of alcohol from corn; (11) Present alcohol capacity; (12) Cost to the consumer.

G. R. N.

1072. Use of Bitumen for Stone-Paved Roads. M. Busch. *Bitumen*, 1933, **3**, 136–139.—In Breslau, cement-mortar has been used for some years to fill the joints between the stones in roads of this type. Bitumen has certain advantages. Mixtures of bitumen and mineral material (*e.g.*, 50% bitumen and 50% powdered lime or cement) have been employed, but the process is not a cheap one, and the introduction of emulsions suggested a cheaper

procedure. The latter are particularly useful with small paving stones, as the emulsion can penetrate the narrowest joints. After the former breaks down, the water can disperse in the foundation of the road. With old roads made with large paving setts, the joints must first be scraped out and preferably blown free from dust or washed by a powerful steam of water. The joints are then filled with sharp sand, chips or grit to a depth of about 5 cm. The emulsion is then poured in. In general, two methods are employed: either the emulsion is poured into each joint or it is poured over the whole surface. In the latter case there is the risk that the smaller cracks may not be filled. Recently, warm bitumen-emulsion has been used.

Certain cost figures are quoted and a series of photographs illustrates the results of some practical tests. The surfaces obtained are good, and it is concluded that there is an important future for bitumen in this connection.

C. C.

1073. Progress in Road Construction with Bituminous Emulsions. W. Geissler. *Asphalt u. Teer*, 1933, **33**, 593–599.—Emulsions are divided into three classes—normal, slow-breaking and stable, the last group including emulsions with both inorganic and organic water-insoluble emulsifiers. The advantages of emulsions (compared with hot processes) are enumerated in detail. The various possible applications of these products in road construction are then discussed.

In some cases, certain disadvantages which the normal type of emulsion possesses for surface treatment may be overcome by using products with higher viscosities, *e.g.*, on steep slopes. Surface coatings may also be prepared with graded stone (*e.g.*, 60% chips and 40% sand) mixed with an emulsion which breaks by evaporation of the water. In addition, a surface may be obtained, using bituminous mortar, prepared with a stable emulsion, sand and filler.

Grouted macadam surfaces include complete and semi grouting with normal emulsion or treating the usual macadam surface with sand and a thin stable emulsion.

Other road-construction methods are discussed, such as mixture—macadam and fine asphaltic concrete. Certain special processes for which emulsions are suitable are briefly discussed, including surface-coating uneven stone pavements (in which process slow breaking emulsions have advantages), the preparation of jointing material for paving stones, and also roughening compressed asphalt surfaces.

C. C.

1074. Food Wrapping as a Hygienic Principle. Anon. *Ind. Chem.*, 1933, **9**, 249.—An interesting table of comparisons of effective resistance of various wrappers for food to passage of water vapour is given. Waxed paper is more efficient than any other described, but its efficiency rapidly decreases after severe creasing.

R. E. D.

1075. Load-Carrying Capacity of Extreme-Pressure Lubricants. S. A. McKee, E. A. Harrington and T. R. McKee. *J.S.A.E.*, 1933, **32**, 217–223.—Several laboratory machines and test methods have been developed for the determination of the properties of a lubricant that are measures of its service performance. Four of these machines for measuring the load-carrying capacity of extreme-pressure lubricants were selected for examination by the U.S. Bureau of Standards. All the machines were used for observing the load necessary to produce seizure when applied to two steel surfaces rubbing together at constant-speed and lubricated with the lubricant under test. The test procedures recommended by the makers of the machine varied in rubbing speed and one or two other quoted points. Preliminary tests with

nine widely-different lubricants indicated a lack of agreement by the machines. Several alterations in test-procedure were made, and the effects of speed and temperature were examined. It was found that :—no set of operating conditions could be chosen for each machine so that all the machines would rate all the lubricants in the same order; the load-carrying capacity of an extreme-pressure lubricant (*a*) tends to decrease as the temperature increases; (*b*) tends to decrease as the rubbing speed increases; the effects of speed and temperature differ with the particular lubricant and machine involved to such an extent that even the order of rating may be changed; the ratio of the applied load to the actual pressure, changes rapidly on running with each of the four machines, which throws serious doubt on the comparability of the data.

A serious difficulty encountered with one machine was that rapid wear usually occurred under the conditions of operation necessary to approach the point of seizure, so that the area of contact increased, and hence the pressure was continually changing.

A new machine is being developed at the Bureau of Standards in which the ratio of the applied load to the actual pressure will remain constant throughout each run. With the machine in view, the speed and temperature may be changed over wide limits and also the action between the surfaces under load may be changed as desired from pure sliding to pure rolling with various intermediate steps of combined rolling and sliding. C. I. K.

Errata

In Abstract No. 725 (p. 309A) a statement is made that 1801 inspections were carried out in the Peace River Area, Alberta, during 1932. These inspections were made in the Province of Alberta generally.

ABSTRACTS.

Class 100. Geographic Occurrence.

1076. Natural Gas in 1931. G. R. Hopkins and H. Backus. *U.S. Bur. Mines Pub.*, 23.5.33, 2, 24.—The total marketed production of natural gas in 1931 was 1,686,436 mil. cu. ft., a decline of 13% compared with 1930. This is attributed to decreased demand for gas for field purposes and for manufacture of carbon black. Exports to Canada and Mexico amounted to 2231 mil. cu. ft. and imports to 44 mil. cu. ft. Drilling of natural gas wells decreased materially. Of the total consumption, 34% was used for field purposes, 23% for domestic and commercial purposes, 12% for carbon black, 8% at electric power plants and 4% at petroleum refineries. Texas remains the principal producing State. Statistics regarding new drilling, production and consumption in various States are tabulated. The number of domestic and commercial consumers has increased appreciably and in 1931 totalled 6,976,450, an increase of 1,420,860, but the majority of the new consumers were supplied with a mixture of natural and manufactured gases. The consumption of gas for industrial purposes declined 17%, as compared with 1930. There was, however, a slight increase in the quantity used by electric power plants. In spite of progress in the technique of piping natural gas, losses are estimated at 12% of the quantity turned into the lines.

Statistics regarding inter-State transportation are tabulated and discussed, and information regarding new pipeline construction given. The number of wells operated in 1931 for production of gas only was about 56,000, and figures for major States and districts are tabulated. The volume of gas treated for recovery of natural gasoline was 1,790,119 mil. cu. ft. R. A. E.

1077. Natural Gasoline in 1931. G. R. Hopkins and E. M. Seeley. *U.S. Bur. Mines Pub.*, 21.4.33, 2, 23.—Production of natural gasoline in the U.S. in 1931 totalled 1,831,918,000 gals., a decrease of 17% from 1930, due to curtailment in crude production. World production amounted to 2,122,168,000 gals. Statistics are given of the number of plants operating, production in various States and counties, production of compression, absorption and charcoal plants and quantities of natural gas treated in various States of the U.S. The average daily production indicates that the industry operated at an average of 47% of its capacity during 1931. The average yield of gasoline per 1000 cu. ft. of gas treated was 1·02 gals. in 1931 as compared with 1·06 gals. in 1930. This is due to the necessity for greater stabilisation in order to remove the light ends. To meet the competition of absorption gasoline produced at refineries the production of finished motor fuel for direct distribution to consumers was increased. Of the total output 77·9% was blended at refineries and 9·7% was exported or sold to jobbers. Substantial increases in cracking and in the production of absorption gasoline have made it increasingly difficult for natural gasoline manufacturers to retain their refinery market and at the same time maintain prices. This is due to the fact that volatility and anti-knock value, the chief qualities imparted through the use of natural gasoline, may usually be obtained at lower cost through proper operation of cracking equipment. Production of butane and propane has increased rapidly, due to growth in stabilisation, and it is estimated that at refineries alone in 1931 the quantities of liquefied petroleum gases produced amounted to 255 mil. gals. The major portion was used as fuel where produced, but the sales to domestic consumers,

gas manufacturers and general industrial users amounted to 28½ mil. gals., an increase of 10½ mil. gals. over 1930 sales. Prices and values are discussed.
R. A. E.

1078. Oil City Revisited. E. H. C. Craig. *Petr. Times*, 1933, **30**, 309.—In the Cameron Creek area is a vast thickness of pre-Cambrian strata in apparently regular succession, divided into well-marked groups dipping south-westerly up the valley, and for about a mile seeps of good quality oil are to be seen. The properties of the oil show that it has not migrated far from its source, and it has passed along joints and bedding planes in the pre-Cambrian, not through fault or crush zones.

A vast thrust bounds the pre-Cambrian massif in the north-east, and a minor, but well defined thrust, possibly of earlier date, bounds Mount Grandell and outcrops in Cameron Creek below Oil City and has oil seeps on its upthrown side. There seems to be a large sigmoid fold with its roots in Alberta or more likely British Columbia, which involves pre-Cambrian, Palæozoic and Mesozoic strata, but little if any of the Carboniferous and Devonian limestone formations are present. These may have thinned out against an island of pre-Cambrian. From the Mesozoic, more especially the Kootenay beds, oil has migrated upwards along joints and bedding planes to give the present seeps. Part of the overturned limb of the recumbent fold is shown in the pre-Cambrian strata exposed in and about Cameron Creek. There is evidence that the plane of the major thrust bends somewhat.

The petroliferous Lower Cretaceous beds seem to be at no great depth, and the oil-bearing rocks are effectively sealed. Although work has proceeded in the dark to some extent, it seems that either porous dolomitised limestone or Kootenay sands can be tapped, and fair and long-continued production is probable from strata below the thrust.
G. D. H.

1079. Study of Overhanging Salt Domes in Coastal Texas and Louisiana. S. A. Judson and R. A. Stamey. *Oil & Gas J.*, 1933, **32** (21), 16, 30; 1933, **32** (22), 18, 22.—Belle Isle, 1898, was the first overhang discovered; Anse La Butte, 1902, was the first producer; but the first big production came from Barber's Hill, 1930. Since then eleven overhangs have been discovered in Texas and Louisiana, nine of which are in the more recent and less consolidated sediments of the coastal plain. The features of a typical salt overhang are stated; theories of their origin are reviewed, while a new theory, of the tilting of the salt plug axis, is introduced. Advanced detection of overhangs is possible by torsion balance, seismic surveys and careful geological subsurface studies. Topographical features are of little use.

Drilling difficulties are considered, the chief one being loss of drilling fluid in the cavernous cap rock; this is overcome by setting casing right up to the cap rock, and drilling with supersaturated salt solution to prevent solution cavities. Crooked holes are likely, but the usual preventive measures are employed. The existence of overhangs is considered most likely in shallow domes, less than 4000 ft., with thick cap rocks. Descriptions and cross-sections are given of Belle Isle, Anse La Butte and Vinton salt domes.
W. J. G.

1080. Prospects of Oil in Utah. G. T. Hansen. *Min. & Met.*, 1933, **14**, 298–299.—There are three places of interest. The Salt Valley structure is an outstanding dome where the salt approaches the surface more closely than at any other point in the area. A test well is being drilled to try and reach the strata below the thick Pennsylvanian salt beds.

Along and almost parallel with the Utah-Colorado State line is the Uncompahgre uplift, where a pre-Cambrian granite mass reaches the surface.

Cloaking it are Permian red beds, and the absence of outcrops of older beds shows that it was land when the Salt Valley formations were being deposited, and hence somewhere around should be an old shore line where these salt basin deposits feathered out. Such shore line conditions are considered favourable for oil accumulation.

In the Uintah basin are Tertiary beds of shale, limestone and sands; also oil seeps, oil shales, gilsonite and elaterite have been observed over a wide area. The Lower Tertiary was folded before the deposition of the Upper Tertiary, and there was further movement prior to the formation of the youngest deposits. Hence structures favourable for oil accumulation may be buried below these later beds. G. D. H.

1081. Florida Geology Not Favourable to Oil Accumulation. W. P. Jenny. *Oil Weekly*, 2.10.33, **71** (3), 23.—The geology of Florida is briefly discussed from the point of view of oil possibilities. It is pointed out that though the stratigraphy does not definitely condemn commercial oil occurrences, especially in the western part of Florida, the gentle and regional structures so far outlined are not favourable to oil accumulation.

By means of the magnetic vector method a number of regional anticlinal trends in the basement, and probably also in the overlying sedimentaries, have been found. These have a northeast-southwesterly direction in the central part of Florida and an eastwesterly direction in the western and southern parts. These regional structural trends seem to be connected with the Appalachian Orogeny and may be of economic interest.

The principle of the magnetic vector method is described. The local magnetic vectors have been computed by deducting the "normal" values of the earth's magnetic field from the absolute measurements at the Coast and Geodetic Survey's stations, of the declination and the vertical and horizontal magnetic intensities. The differences between the absolute and the "normal" vertical and horizontal intensities have been combined into a vector triangle, indicating the direction and intensity of the magnetic force as due to local anomalies. The vector triangles have been plotted on the map by turning the triangle through 90° around the horizontal component into the plane of the map. L. V. W. C.

1082. Western Canada Oil. G. S. Hume. *Oil News*, 1933, **33**, 517, and **34**, 144.—The area of pre-Cambrian outcrops in Western Canada is given together with a brief history of the geological thought concerning the area and its exceptional oil seepages.

The Waterton-Flathead area, where oil was reported at 3260 ft. in pre-Cambrian, has the following stratigraphy: Recent, Eocene (?), Kishinene, Cretaceous, Jurassic, Pennsylvanian, Mississippian, Devonian, Silurian, Cambrian, pre-Cambrian Lewis Series. The seeps on Cameron Brook near Oil City are related to structure, a group of faults being present. Oil prospects at Cameron Brook anticline and Oil City may be assumed thus: The highly metamorphosed Lewis Series is an unlikely source rock, hence it is believed that the oil originated in the Mesozoics below the Lewis thrust and the presence of large oil accumulations in these strata depends on the Cameron Brook anticline extending downwards across the thrust into them, since the pre-Cambrian strata are too hard and dense for reservoir rocks, except where excessively shattered and faulted. Possibilities at Sage Creek, Fisher-Elder Creeks, and Kishinena Creek domes depends on the presence of conditions similar to those postulated for Cameron Brook, and the thrust may be even deeper at those places.

The greater part of the southern end of the Flathead Valley is covered with Tertiary freshwater beds, which dip eastwards with some folding. Indigenous

oil is unlikely, but these surface folds may be indicative of favourable structures in the underlying Mesozoics. G. D. H.

1083. Petroleum in France. N. Pervouchine. *Mon. Petr. Roum.*, 1933, **33**, 1101–1108.—France is the fourth largest consumer of petroleum. Her imports have multiplied three times in the last 10 years—4,488,575 metric tons were imported in 1932, of which 40% was crude. Production in France is small, 74,000 tons being produced in the Pechelbronn district in 1932 and 4800 tons from bituminous shale (Autun) in 1931.

The laws affecting the petroleum industry in general and refining in particular are outlined. Refining has increased enormously in line with the imports of crude. The proportion of the various refined products are given in a table. The authorised production for each refinery is given.

In 1930 practically the whole of the crude came from Venezuela and Persia, but in the first six months of 1933, 40% came from U.S.A., 27% from Venezuela, 14% from Dutch Indies, and 10% from Persia. Details of the companies concerned are given, and the customs and excise taxes are tabulated. C. C.

1084. Physical and Chemical Properties of North German Petroleums. G. Keppeler. *Petr. Z.*, 20.9.33, **29** (37), 6–7.—The properties of the oils from the following principal producing fields are tabulated, and a comparison made of the different oils: Wietze Steinförde, Oberg-Ölheim, Nienhagen, Thüringen and Volkenroda. The properties given are the depth of the productive layer in metres, density at 20° C., percentages of olefinoid, aromatoid, paraffin-naphthene, total asphalt, low-boiling constituents to 150° C. and constituents boiling between 150° and 200° C. W. S. E. C.

1085. Study of Some Menilite Shales from the Flysch Zone of the E. Carpathians. E. Casimir, M. Dimitriu and V. Pasca. *Petr. Z.*, 20.9.33, **29** (37), 1–4.—The shales were obtained from the Valea Agapia, Valea Sarcia, Valea Horaita in the Neamt region and Hârja from Bacau. They were analysed and percentage of water, inorganic and organic constituents determined. The amount of water was found after heating to 200° C. and on further distillation to 650° C. in a stream of carbon dioxide a gas and oil were produced and a coke residue containing mineral substances. The content of organic substances was very high and contained agglomerates of amorphous iron sulphide and pyrites crystals. The following constituents were determined in the inorganic substances: Carbonates, sulphur (as free S, $CaSo_4$, FeS_2, organic S and total S), SiO_2, Al_2O_3, TiO_2, P_2O_5, MnO, Fe_2O_3, Fe as FeS_2, CaO, MgO, CO_2, and water.

The content of organic substances varies from 2·5 to 14%. Those layers, rich in clay (35% of clay), have a very high content of organic constituents, Agapia shale having the greatest quantity; on the other hand those layers rich in calcium carbonate contain quite small quantities.

The organic substances are formed from 10% of soluble bitumen, the rest consisting of insoluble polybitumen (Kerogenbitumen) of the following composition: 90% carbon, 7·5% hydrogen, and the remainder sulphur, nitrogen and oxygen. Gradual heating to 650° C. decomposes it into 15% of gas, 27% of oil and 58% of a coke residue. In the soluble bitumen and in the distilled oil 100 parts of carbon correspond to 12·2 or 12·8 parts of hydrogen against 8·4 parts in the crude organic substance in the layer.

The presence of abundant amorphous iron sulphide, combined with the bitumen content, and the reaction towards potassium hydroxide show a

similarity of these layers to sapropel layers found in salt lakes. The Oligocene bituminous layers of the Flysch zone possess clay-like bituminous sediments of marine origin, which covers the outer zone of the Carpathian range in the Palæogene. W. S. E. C.

1086. Composition of Ural-Petroleum (Perm.). N. S. Zelinsky and J. K. Juriew. *Brenn.-Chem.*, 1933, **14**, 347–349.—In an earlier investigation into the fraction of Ural-Benzine, boiling under 150° C., it was shown that this benzine in addition to a notable quantity of aromatic hydrocarbons also contains hydro-aromatics, which were estimated by means of the catalytic dehydrogenation method of Zelinsky. The residue remaining after separation of the groups mentioned consisted principally of paraffins. In the present investigation the fraction of Ural petroleum of boiling range 150–240° C. was examined.

The fraction, n 1·4856, d 0·8529, S 1·58%, was shaken with mercury salts to remove sulphur, and the filtered liquid fractionally distilled over freshly reduced molecular copper, into six fractions. By a treatment of the fractions with sulphuric acid it was found that their aromatic content gradually diminished from a maximum of 72·1% by weight in the case of the first fraction, to a minimum of 47·9% in the last. The fractions freed from aromatic hydrocarbons were analysed for hydro-aromatics using catalytic dehydrogenation. The aromatics produced by this reaction varied irregularly from 7·8 to 10·3% by weight of the original fraction as distilled.

The residues of the fractions remaining after removal of the aromatics and the hydro-aromatics consist of mixtures of paraffins and polymethylenes as evidenced by the elementary analysis and their critical solution temperature in aniline. The percentages of both cyclo and straight chain paraffins found were a minimum in the fraction of lowest boiling point, and rose gradually throughout the series, from minima of 6·5 and 12·5% to maxima of 17·1 and 25·2% respectively, all by weight.

Examination into the structure of aromatic hydrocarbons present led to the conclusion that no naphthalene, either itself or as a hydro derivative, is present. B. C. A.

1087. Koschagyl and Iskine, Southern Emba. Anon. *Oil News*, 1933, **34**, 232.—Koschagyl field 180 km. south-east of Dossor is a typical salt dome divided by a fault into north and south parts which give rise to five separate fields. Numerous seeps are known, particularly on the northern or lower portion of the dome. The first well on the north entered the Dossor Jurassic horizon at 290 m. and passed through three sets of oil sands in 108 m. The second and third were the more productive. Since the full oil-bearing series in the Jurassic is estimated at 500 m. in this region, and only the upper 100 m. have been examined here, the field seems to have great potentialities.

Another important area is the Iskine dome on the southern Emba. Drilling was commenced in 1932 1 km. south of a sharp salt structure which had been detected electrically, and at 669 m. the Jurassic was reached and oil sands found.

There is a large number of favourable structures in the Uralo-Emba district, and the oil-producing part of the region is not limited to the 130 sq. km. prospected and known. Signs of oil are found in the Ust-Urta districts along the Uralok-Saratov line and plentiful gas vents on the Astrakhan steppes. The 265 known domes have not been examined sufficiently geophysically, and deep exploratory work is going on in 22 places, but that is only a very small part of the work to be done. G. D. H.

1088. Ural Emba Oil Region. V. Selsky. *Petr. Times*, 1933, **30**, 252.—This area is peppered with salt domes and was drilled chiefly subsequent to 1890, but most of the wells were short-lived. Now the only fields being exploited are Dossor, Makat and Baychunas. Prospecting now being carried out over the area has revealed 17 domes and shown that oil is not restricted to the area worked in the south; that in places the petroliferous series may attain 100 m. in thickness and be highly saturated, and that the Permo-Carboniferous is petroliferous in addition to the more frequently explored Jurassic. Fifty-two of the 210 domes known were worked in 1932. Salt workings and gravity anomalies show that the domes may extend to the Volga, and domes found near Orenburg and Uralsk may connect this district with the Sterlitamak field.

Oil has not been found in the cap-rocks when the latter are present but is found in the adjacent strata. The strata beneath the salt in the Aktubinsk region has been shown to be oil-bearing, but so far the salt has not been penetrated. Important sands are known at Shubar-Kuduk and Murshuk domes and a field was opened at Kos-Chagyl in 1932. At Emba work has scarcely begun and the value of contact accumulations has not been explored.
G. D. H.

1089. Lok-Batan. Anon. *Oil News*, 1933, **33**, 490.—This field borders the Caspian. Up to the present nine productive horizons have been found between 900 and 950 m. in depth, the upper horizons giving the lighter oils. As yet the upper parts of the lower beds of the productive series have scarcely been touched, and experience has shown that the oil saturation increases with depth. Water has not been met with the oil which seems to indicate that edge water is some considerable distance from the exploratory wells. In little more than a year from the commencement of exploitation it was possible to operate no fewer than 800 wells in this field. G. D. H.

1090. Imports of Petroleum Products into Denmark. Anon. *Mon. Petr. Roum.*, 1933, **33**, 1125–1127.—No petroleum is produced in Denmark. Tables give the imports of the various products from 1923 to 1932. In the latter year total imports were 612,378 metric tons, of which 41% came from England, 26·5% from Russia, and 26% from U.S.A. For the first six months of 1933, total imports were about 267,000 tons, of which 59% came from England, 28% from Russia, and only 4·5% from U.S.A. (At present there is one petrol pump for every 13 motor vehicles in the country, about 11,000 pumps in all.) C. C.

1091. Australian Geological Surveys Encourage Drilling for Oil. Anon. *Oil Weekly*, 1933, **70**, 36–37.—Australia seems to have rocks of all ages from pre-Cambrian to recent with the possible exception of Eocene, and oil indications have been found in the Cambrian of Western Australia, the Jurassic of Queensland and Tertiary of Victoria and South Australia, but the Lower Cretaceous and Tertiary are expected to prove the most important oil sources. Suitable structural conditions are said to exist.

The great Tertiary Valley of Victoria has been shown to extend into South Australia, and was bounded on the south by ranges of Proterozoic rocks with a N.W.–S.E. trend. There is evidence of inland Cretaceous seas north and south of the Proterozoic divide, and the south-eastern part of South Australia was occupied by a lobe of the great Cretaceous sea. Epeirogenic and orogenic forces have operated since early Pliocene times and basaltic eruptions have occurred near hidden peaks of Proterozoic rocks. Folds have been observed in the surface rocks not directly associated with volcanic products, but the latter have also been affected, and the folding

has been determined by the buried ranges of Palaeozoic rocks as shown by the N.W.-S.E. trend. Little oil has been found in the Oligocene, but some may have migrated thence from a lower Cretaceous source. The Oligocene seems to contain some impervious beds, for oil is only seen along fault lines, where Proterozoic rocks intrude, or where they are indicated by basaltic plugs. Oil exudes from a volcanic ash at Bridgewater, and at a number of places it occurs under cover of basalt in Miocene limestone along lines of uplift. G. D. H.

Class 200. Geology and Origin.

1092. Contribution to the Knowledge of Sedimentary Volcanism in Trinidad. H. G. Kugler. *J. Inst. Petr. Techn.*, 1933, **19**, 743–772.—A lecture with discussion at the Trinidad Branch on views based on observations made there of the nature of sedimentary volcanism in Trinidad. G. R. N.

1093. Origin of Western Kentucky Asphalt Deposits. W. L. Russell. *Econ. Geol.*, Sept.–Oct., 1933, **28**, (6).—The asphalt deposits are found on the south-eastern edge of the Eastern Interior Coal Basin. The Pennsylvanian series here is unconformable with the Chester Series of the Mississippian. Most of the important deposits occur in basal Pennsylvanian and the Cypress sandstone of the Chester series. The oil and gas pools are situated to the east in Silurian, Devonian and Lower Mississippian limestones, also to the west in Chester and Pennsylvanian sandstones. The general structure is dipping to the north-west and a feature of it is the Rough Creek Uplift running east-west. The deposits, however, show little relationship to the regional structure.

It seems probable that the oil in the Cypress was altered by the circulation of ground water before it reached the surface. The derivation of the deposits probably is not from the Chattarooga shale, as the Osage limestone above the latter shows no oil and is scarcely permeable. Migration of the oil was probably limited up-dip for a few miles, and the source, is thought, therefore, to be the shales associated with the deposit.

With the paper are included a section, stratigraphical table and a map. P. A. S.

1094. Geological Classification of Petroleum Accumulations. B. G. Escher. *De Ingenieur*, No. 33 (*Mijnbouw* 4), 1933.—A critical and historical review is given, illustrating the inadequacy of the anticlinal theory for describing all types of oil deposits, with a discussion of published views of Blumer and others.

A-Tectonic accumulations, independent of tectonic influences, are explained in some detail, their origin being attributed to primary sedimentation in conjunction with compaction. The possible groupings of uniform spheres and the resulting pore spaces are discussed with reference to the view of Versluys and Athy that migration is a consequence of compaction. The course of oil migration is given as follows :—

Compaction ⟶ migration of an oil-emulsion into sand ⟶ filtration of emulsion ⟶ separation of emulsion into oil and salt water. The following classification of oil accumulations is given with examples of each type :—1. A-Tectonic ; 2. Tectonic, sub-divided into accumulations influenced by (*a*) folding (anticlinal oil), (*b*) unconformity, (*c*) faulting, and (*d*) aureole accumulations.

A bibliography is appended. P. G. H.

1095. Flow of Simple Fluids through Porous Materials. G. H. Fancher and J. A. Lewis. *Ind. Eng. Chem.*, 1933, **25**, 1139.—The previous literature relating to fluid flow through packed and unpacked conduits is reviewed by the authors. The apparatus and method used for the study of the flow of fluids through permeable media are described. Crude petroleum, water and air were passed through several arrangements of unconsolidated sands and samples from many sandstones. The latter were cores from producing horizons in oil wells. The data obtained were inserted in the equation :

$$f = \frac{g\,d\,\Delta p}{2\rho L U^2}$$

where f = friction factor ; g = 32·2 ft. per sec ; d = diameter of average grain in feet ; Δp = pressure drop in lb. per sq. ft. ; L = length of core in feet ; ρ = fluid density in lb. per cu. ft. ; U = apparent velocity in ft. per sec. ; and the value of f calculated. The friction factor was plotted against the modulus $\frac{d\,U\,\rho}{\mu}$ where μ = absolute viscosity in lb. per sec. per ft., and excellent correlation and alignment of the data for unconsolidated sands were obtained. The flow of fluids through unconsolidated and consolidated sands resembled that through pipes, and there was a definite change from viscous to turbulent flow, as the velocities were increased. It was found that the change from one type of flow to the other took place at a definite and reproducible condition for each system.

While it was possible to draw a curve on the chart for each unconsolidated material, these curves were sufficiently close together for engineering purposes to permit an average line for all the unconsolidated sands to be drawn. The curve for each consolidated sand on the chart was displaced from that for the loose sands by an amount proportional chiefly to the quantity and arrangement of cementing material, but also to smallness of average grain diameter and angularity of the grains. By the use of the chart, provided screen analyses of the sand were known, it was possible to compute conditions of flow for any fluid through the average consolidated, and for all unconsolidated sands with some degree of precision. E. N. H.

1096. How Deep may Oil Exist in the Earth's Crust. R. A. Jones. *Oil Weekly*, 25.9.33, **71** (2), 20.—The science of geology has so far failed to find continuous thicknesses of sedimentary rocks in any one locality in excess of a total of from 20,000 to 40,000 ft. Sedimentation apparently seldom attains a thickness of more than 20,000 to 30,000 ft., and conversely it would appear that only in very rare instances do unaltered sedimentary rocks persist to a greater depth than 30,000 ft.

The data presented in this paper show that the pores and cavities necessary to the accumulation of petroleum may extend in granite to a depth of 11 miles and cavities in limestones to a depth of 9 miles. Since under ordinary conditions 30,000 ft. of deposits is a maximum that can be expected, the writer concludes that the maximum depth at which oil may occur is in certain embayments, basins or coastal plains at a depth of from 4 to 6 miles.
L. V. W. C.

Class 300. Development and Production.

1097. Progress in Petroleum Mechanical Engineering. Anon. Trans. A.S.M.E. *Petr. Mech. Eng.*, 31.5.33, **55** (6), 1–6.—A survey of the progress made on American oil fields during the year 1932. Under the heading of refining such subjects as the commercial introduction of hydrogenated motor fuels and

lubricants, 10,000 and 20,000 brl. capacity cracking units, and an improved type of heat exchanger for use with high temperatures and pressures are dealt with. Under transportation progress attention is drawn to the further use of the gasoline-motor-driven unit for gathering oil as a replacement for the steam pump, also to the substitution of Diesel engines for electric motors, as pump driving units, where electrical power has to be purchased. Tendency of 3 in. pipe and fittings to become obsolete in view of the greater use being made of 2 in. and 4 in. sizes, and for a reduction in wall thickness of 8, 10 and 12 in. sizes of pipes. The use of heat exchangers for closed cooling-water systems for Diesel engines, making use of the crude oil pumped for cooling the water, has been extended. Motor transport, welding and pipe-line bridges are also commented upon.

Regarding production practices the progress made in well-pumping equipment, bottom hole pressure gauges and hoisting equipment is outlined.

W. W.

1098. Drilling and Production Practice. *Proc. A.P.I. Prod. Bull. No.* 211, May, 1933, 115–119. Appendix "H."—*Drilling Practice.* Mr. A. C. Rubel suggested that the most important matter before the industry to-day is reconditioning, *i.e.*, re-drilling, deepening, cleaning out and otherwise restoring producing wells which have declined to uneconomic limits by reason of water encroachment or other causes, and that a thorough study of this phase of operations should be undertaken.

Attention was directed to the economies effected by detailed co-ordination and standardization of tearing down, moving, rigging up and operation of rotary drilling equipment by the Humble Oil and Refining Co. in Texas. These had enabled rigs to be moved and rigged up completely in two days and wells to be drilled to 3600 ft. in 10 days and 5200 ft. in 17 days. (Ref. article by J. V. Teague in *Oil Weekly*, April 10th, 1933.) Among other practices discussed were the following:—Reconditioning of wells, relation of efficiency to a five-day week; relation of drilling muds to drilling time; the possibility that putting special drilling tools on a rental-charge basis promotes economies within the company; full-hole tool joints; wire-line core barrels; collapsible bits; pressure-type bailers; left-hand threads on casing; perforation cleaners and blow-out preventers. Steam-operated blow-out preventers are being adapted to be operated by water pressure, due to the fact that steam will not keep the rams sufficiently locked, due to condensation and compressibility of the steam.

Committees were requested to compile a report describing the new drilling and reconditioning practices.

Production Practice. The allocation of production between producers from a common pool operated under restricted total output was discussed. Factors such as physical waste, reservoir pressures, acreage, sand characteristics and potential production were conceded as important functions of an allocation method. The meeting expressed favour of an active continuation of study and conference upon the foregoing subject matter. It was urged emphatically that the special committee appointed should ignore legal aspects and confine itself to the physical and engineering aspects entirely. It was assumed that laws will eventually have to adjust themselves to physical conditions. It was agreed that the committee should not consider the question of allocation between pools, but confine its activities, for the present at least, to the allocation of production in the pool itself.

Development and Production Research. Programme for year to include a study with the object of standardizing the procedure and nomenclature for permeability and porosity determinations; also the question of permeability

determination of unconsolidated sands and of arriving at values of permeability from data taken in the field. The Pennsylvania State College is preparing a comprehensive report on porosity determination methods now in use.

The California sub-committee recently held a meeting at which a second problem was suggested, this being a study of the relative merits of gas and water as agencies for flushing oil from sands. It was agreed that the problem be divided into two phases: 1, the relative extent to which water and gas flush the oil out of the sand through which they pass; 2, the relative extent to which these agencies "finger" in advancing into an oil sand.

Metallurgy of Oil Field Equipment. A preliminary report from F. W. Speller, was read—discussing the results obtained to date on the investigation of protective coatings for the prevention or retardation of corrosion fatigue of sucker rods, tubing and other items of underground equipment subjected to repetitive stresses in service. The investigation will include coatings of the following kinds: baked enamels, rubber paints, synthetic resins, electro-plated metals and sprayed metals. A detailed survey of the problem of failures in drill-pipe joints will be made by the South-western District Sub-Committee and submitted at the next meeting of the topical committee.

Programme Committee. The central committee proposes the publication of special bulletins on some of the following subjects:—Well spacing, rotary-drilling mud, unit operation, etc. It is now proposed to review all previously published matter, condense and publish it in single pamphlet form. W. W.

1099. Standardization. *Proc. A.P.I. Prod. Bull.*, No. 211, May, 1933, 113–114. Appendix "G."—*Belting.*—Proposal that changes be made in the elongation stipulations referred, with other suggestions, to the engineers' sub-committee for consideration and comment.

Boilers.—Proposals relating to fire-box size to boiler horse-power, the dome location, number and arrangement of hand holes and arrangement of flues, referred to the manufactures' sub-committee for study and report at a future meeting. A caution regarding the use of fusible plugs proposed for insertion in the relative code. Industry circularised for further information in connection with the demand for establishment of higher working pressures.

Cable Tools.—B.S.I. expressed a desire to purchase a complete set of cable-tool gauges for use in checking manufacturers' reference master gauges.

Derricks.—A number of items, intended to clarify or strengthen the specification, referred to special committee, including such matters as dead-line anchorage, base plates and safe-load capacity of water-table beams.

New specifications on capacity of wood walking beams approved.

Tubular Goods.—A proposal to change the bevel on plain end line pipe, together with clarifications and additions to the order form referred to committee for decision. A proposed specification on welded line-pipe jointers approved and final details now being adjusted.

Rig Irons.—Changes for the specification proposed, these including clarifications or new dimensions on such items as shafting, calf-wheel sprockets and set collars, referred to the entire committee and approved.

Rotary Drilling Equipment.—Tentative sizes and dimensions regarding full-hole tool joints agreed upon. Present standard on regular sized tool joints will not be abandoned. Committee is also considering addition of dimensions on shafting, keys, keyways and bored members in sizes 6½ to 10 in. inclusive.

Committee has proposed to make the standards on line shafts (No. 7-C.) apply to all shafting used in rotary drilling.

Wire Rope and Manila Cordage.—Completion and adoption of a standard laboratory data form for testing wire rope, as well as a number of minor changes in the specification now before committee.

Pumping Equipment.—Committee has still before it the adoption of standards on inserted pumps; also, considering the adoption of a standard nomenclature for pumps and of a rating form for pumping machines; now has ready for final ratification codes on the care and use of gas engines and of cold-drawn working barrel pumps.

Tanks.—Committee adopted stipulations on appurtenances and the strengthening of these appurtenance designs has been referred to a special committee. The inclusion in the riveted tank specification of a permissible variation in rivet spacing of top and bottom sheets, to accommodate multiple punches now in use, approved. Committee also working on specifications for small, all-welded production tanks, and is continuing the study of welded bottoms for riveted tanks. W. W.

1100. Chart for Modern Short Centre Belt Drives. W. F. Schaphorst. *Petr. Eng.*, Sept., 1933, **4** (13), 16.—A nomograph is presented which enables the proper belt width to be used, to be calculated from a knowledge of the diameter of the smaller pulley, the speed of the belt and the horse power to be transmitted. L. V. W. C.

1101. Fire Prevention in Oil Fields. *Proc. A.P.I.Prod. Bull.*, No. 211, May, 1933, 102. Appendix "C."—Committee to consider a report, in the near future, from its sub-committee which was charged with the preparation of a publication on the subject of fire protection in oil fields. W. W.

1102. New Drilling Depth Record for Texas. W. L. Baker. *Petr. Eng.*, Sept., 1933, **4** (13), 70.—The deepest oil well within the State of Texas has reached a depth of 9,863 ft. in Liberty County.

The shale formation in this district was successfully controlled by the scientific treatment of the drilling fluid, and at no time has any trouble been experienced in circulating cuttings from the hole.

Care of equipment and careful control of drilling operations have enabled this record to be made. L. V. W. C.

1103. Some Problems in the Lubrication of Vertical Journal Bearings. A. I. Ponomareff and E. D. Howe. *Trans. A.S.M.E. Petr. Mech. Eng.*, 31.5.33, **55** (6), 27–36.—In deep-well pumping a motor at the surface drives a pump runner at the water level through a long vertical shaft supported at the top by a thrust bearing and guided at intervals of its length by journal bearings. For effective design the power absorbed by the journal bearings should be known approximately. The preponderance of horizontal shafts in various kinds of machinery has resulted in an extensive literature on their lubrication, but there is little that bears on the lubrication of such vertical shafts as are used in pumps, hydraulic turbines, a few steam turbines, cream separators and centrifuges. The friction loss in these is small, but in the deep-well pump the loss may be as great as 5% of the power input. The paper relates the details of an investigation to establish some of the basic facts underlying the lubrication of vertical journal bearings such as are used in deep-well pumps. W. W.

1104. Solving Well-Pumping Equipment Problems. H. Ledeen. *Petr. Eng.*, Sept., 1933, **4** (13), 60.—This article deals with transmission between parallel shafts and with double and single helical gears.

The accuracy of division determines the limit of angular velocity at which herringbone gears can be successfully operated. Herringbone gears will operate at any velocity within the safe limit of centrifugal stress for the material of which it is built.

A wide range of choice for the spiral angles of herringbone and helical gears exist, and this factor has been examined at some length.

Strength is not a factor in the design of steel herringbone gears for ordinary purposes and materials should be chosen for resistance to surface abrasion.

Pitch diameters, enlarged pinions, etc., are also dealt with. L. V. W. C.

1105. Determining Size of Electric Pumping Equipment. W. C. Lane. *Petr. Eng.*, Sept., 1933, **4** (13), 20.—With the advent of the pumping stage in East Texas the selection of units are of great importance if these properties are to show a profit.

Basic principles must be adhered to in the selection of motors if costly errors are to be avoided. L. V. W. C.

1106. Capacities and Loads of Gear Units on Pumping Wells. P. C. Day. *Oil Weekly*, 18.9.33, **71** (1), 22.—Since equipment having a load carrying capacity less than the actual loads to be carried will fail due to breakage, it is necessary to know: (1) the load carrying capacity of the equipment considered, and (2) the loads likely to be encountered, if costly repairs and lengthy shut downs are to be prevented. The most desirable equipment is that whose load carrying capacity is equal to or only slightly greater than the load requirement.

A list of the various parts of which a gear unit usually consists is given, and each of these headings is discussed in some detail. L. V. W. C.

1107. Characteristics of Edgewater Encroachments in California Fields. V. H. Wilhelm, E. L. Davis and W. A. Clark. *Oil Weekly*, 9.10.33, **71** (4), 13. —The importance of an adequate and controlled edgewater drive is becoming more apparent and is beginning to receive attention.

Current theories are examined in this paper, and the authors then deal with the various periods such as Gas Expansion, Combination, Water Drive and Gravity Drive. L. V. W. C.

1108. Accident Prevention. C. L. Hightower. *Petr. Eng.*, Sept., 1933, **4** (13), 39.—The control of accidents in the oil industry in the United States has resulted not only in the saving of human lives but also in a saving of millions of dollars to employees through the lessening of absenteeism.

Accident prevention is considered to be the indication of correct operation, and the three major activities of the accident prevention programme are: engineering revision in lay-out and construction, proper maintenance of equipment and training of workers concerning safe practices.

Operations about the wells have been revised and accident hazards have thus been reduced. Installation of vapour recovery systems at storage tanks and methods of detecting toxicity and explosibility ranges for vapours in storage tanks, etc., are some of the advances made that have contributed to the safety of petroleum workers.

In fact any programme that takes into account advanced engineering principles in design and lay-out maintenance of equipment and training of the workers in safety, practices will definitely experience a lower accident frequency. L. V. W. C.

1109. Accident Prevention in Production. *Proc. A.P.I. Prod. Bull. No.* 211, May, 1933, 102. Appendix "D."—A manual of precautions in well pulling has been prepared and reviewed by the Committee, and its approval for publication recommended.

Studies are under way on precautions for the oil field pumper, and accident prevention in rotary drilling. W. W.

1110. Patents on Drilling Apparatus. F. Allburg. U.S.P. 1,925,223, 5.9.33. Method and apparatus for determining the inclination of a well.

D. S. Faulkner and E. Timbs. U.S.P. 1,925,314, 5.9.33. Rotary Draw Works Brake.

D. A. Murphy. U.S.P. 1,925,335, 5.9.33. Ball Joint Steel Hose Coupling.

E. Timbs. U.S.P. 1,925,348, 5.9.33. Pumping Machinery.

E. Timbs. U.S.P. 1,925,349, 5.9.33. Rotary Draw Works.

D. H. Reed. U.S.P. 1,925,404, 5.9.33. Outside Pipe Cutter.

W. D. Shaffer. U.S.P. 1,925,406, 5.9.33. Casing Head for Oil Wells.

D. G. Lorraine. U.S.P. 1,925,491, 5.9.33. Oil and Gas Separator.

H. R. Standill. U.S.P. 1,925,852, 5.9.33. Oil Saver.

W. T. Wells. U.S.P. 1,926,017, 5.9.33. Packer.

A. Boynton. U.S.P. 1,926,030 and 1,926,031, 12.9.33. Automatic Stage Lift Flowing Apparatus for Wells.

A. L. Leman. U.S.P. 1,926,856, 12.9.33. Casing Head.

J. B. Winsor. U.S.P. 1,927,055, 19.9.33. Method of and apparatus for pumping wells with pressure fluid.

T. E. Bryan. U.S.P. 1,927,081, 19.9.33. Fluid operated well valve.

O. K. Stephens. U.S.P. 1,927,190, 19.9.33. Casing landing, packing and blow-out prevention assembly.

C. R. Edwards. U.S.P. 1,927,310, 19.9.33. Well Cleaning apparatus.

C. R. Hetzler. U.S.P. 1,927,494, 19.9.33. Well pumping device.

J. C. Karcher. U.S.P. 1,927,664, 19.9.33. Bore hole exploration apparatus

F. W. Hild. U.S.P. 1,927,831, 26.9.33. Motor-driven oil well pump.

F. J. Kightlinger. U.S.P. 1,927,836, 26.9.33. Rotary jar.

J. S. Abercrombie. U.S.P. 1,927,863, 26.9.33. Whipstock for wells.

J. T. Simmons. U.S.P. 1,927,958, 26.9.33. Apparatus and method for removing fluids from wells.

E. O. Bennett. U.S.P. 1,928,122, 26.9.33. Stuffing box mounting for well pump rod.

J. G. Gillespie. U.S.P. 1,928,532, 26.9.33. Method of and apparatus for applying power for the operation of reciprocatory pumps.

F. S. Bunker. U.S.P. 1,928,644, 3.10.33. Drift measuring and recording apparatus.

W. J. Newman. U.S.P. 1,928,947, 3.10.33. Drilling apparatus utilizing drill pipe with longitudinal slots extending the full length for receiving drive members.

F. J. Young and D. A. Murphy. U.S.P. 1,928,957, 3.10.33. Joint steel hose.

F. J. Young and J. D. Spalding. U.S.P. 1,928,958, 3.10.33. Crown block.

G. C. Kuffel. U.S.P. 1,988,969, 3.10.33. Well surveying apparatus.

N. Johnston. U.S.P. 1,928,970, 3.10.33. Well surveying apparatus.

W. E. Rose. U.S.P. 1,929,077, 3.10.33. Deep well turbine pump.

L. V. W. C.

1111. Patents on Crude Oil.—M. de Groote. U.S.P. 1,926,715, 12.9.33. A demulsifying agent is described for breaking water-in-oil types of emulsions. The agent contains a fatty sulphonic acid body in which the acid is derived from a liquid unsaturated fatty material having a single ethylene linkage. The sulphonic acid radicle is attached to a carbon atom other than the conventionally reactive carbon atoms.

W. H. Elliott. U.S.P. 1,928,282, 26.9.33. Resolution of emulsions by heating under pressure followed by transference to a closed settling zone also under pressure. The settling zone is cooled and the pressure reduced to below atmospheric, after which layers of oil and water are withdrawn separately.

W. H. T.

Class 400. Transportation, Storage and Distribution.

1112. Corrosion of Oil Field Equipment. *Proc. A.P.I. Prod Bull.*, No. 211, May, 1933, 101, Appendix "B."—Committee succeeded in raising a special corrosion fund, by direct appeal to pipe line companies, amounting to 80% of the usual annual budget of the A.P.I. Co-operative Pipe Coating Tests. The fund is being expended largely this year in maintaining a research associate at the U.S. Bureau of Standards to continue the pipe coating tests. The Committee was of the unanimous opinion that the A.P.I. Co-operative Pipe Coating Tests should be continued through 1934. In future the Committee will be known as the Committee on Corrosion of Pipe Lines.
W. W.

1113. Checking Gas Booster Plant Operation with Temperature Gauges. W. L. Baker. *Petr. Eng.*, Sept., 1933, **4** (13), 24. In many instances the natural well pressure is sufficient to send the gas from the fields through the gasoline plants and the transmission system to the various points of consumption. With low pressure residue gas this is not possible, and it is necessary to boost the pressure to maintain the desired flow by means of compressors. Scientifically-operated and controlled plants are necessary if efficient operation is to be possible.

To determine whether each compressor is doing its part efficiently a knowledge of compressor gas inlet and discharge temperatures is necessary. Defective conditions in the operation of compressors are indicated by the temperature of the cooling water, and thermometers, set to sound an alarm at some pre-determined temperature, are of definite value in determining the mechanical condition of the compressor.

Recording thermometers are also available capable of recording compressor gas suction temperatures, gas discharge temperatures and the temperatures of the gas from the after coolers on a single chart. L. V. W. C.

1114. Measuring, Sampling and Testing Natural Gas and Natural Gasoline. *Proc. A.P.I.Prod. Bull.*, No. 211, May, 1933, 106–112. Appendix "F."—Committee dealt with the appointment of sub-committees for the various sections, and suggestions for carrying on the work of developing a general code or procedure covering the various operations necessary in measuring, sampling and testing natural gas and natural gasoline. W. W.

1115. Measuring, Sampling and Testing Crude Oil. Code 25. *Proc. A.P.I. Prod. Bull.*, No. 211, May, 1933, 97–101. Appendix "A."—Records the work in hand of the committee dealing with this code; this is summarised by the following notes: Proposed changes in par. 14 of the code, relating to circumference measurements, discussed and revisions adopted. Footnote. to par. 200 (*b*): Level of Non-merchantable Oil, proposed and adopted. Change made to par. 202 (*c*): Thiefing Depth. New par. 202 (*d*): Additional Samples, added. New par. 202 (*e*): Composite Samples, added. New par. 202 (*f*): Average Samples, approved. Amendment to par. 203 (*a*): Sampling Through Cocks, approved. Change made to par. 203 (*c*): Composite Samples. Amendments to pars. 215 and 217: Determination of B.S. and W., approved. Change made to par. 218: Hand Centrifuge. Change recommended to Fig. 205: Finger Type Centrifuge Tube. Recommendations relating to Study of Diluents and Tube Calibration, adopted.

Chairman appointed for a committee to deal with the Study of Evaporation Losses and Deductions. The recommendations addressed to the A.P.I. by the I.P.T. relating to international basis for oil measurement were presented to the meeting and there were no objections thereto. W. W.

Class 500. Properties and their Determination.

1116. Measuring Oiliness of Lubrication Oils. J. S. Phelps. *Oil & Gas J.*, 7.9.33, **32** (16), 10.—The tester described compares the oiliness of fluid lubricants by measuring the pressure necessary to rupture the oil film. The main frame is sufficiently robust to permit change of bearing size, if necessary. A ¼ in. steel spindle has a single ball set into the top, resting against a hardened steel plate held in the housing carrying the knife edge, and acting as a thrust bearing. The steel weight beam is supported by three polished steel pins, and the weight ratio is 25/1. The unbalanced weight of the spindle, belt, bearings and pulley is 3 lb. The ball bearings on the spindle have a press fit on the spindle end and a sliding fit in the mounting brackets. The lubricant cup is of cast iron and is adjustable so that the weight beam may be adjusted to stand in a horizontal position. The cup holds 250 ml. of sample, into which the test bearings are completely submerged. The top bearing is drilled with a ⅜ in. hole and the outside diameter is such that the rubbing area is 0·2 sq. in. It is secured to the spindle by a cotter key. The bottom bearing is of larger external diameter and is drilled with a hole ⅞ in. in diameter, thus allowing for inaccuracies in alignment and ensuring that the upper bearing has sufficient rubbing area. Subsidiary holes drilled in the bearings permit circulation of oil inside. The lower bearing is recessed at centre bottom to hold a ⅜ in. ball bearing on which it rests and which in turn is set on the bottom of the test cup. On opposite sides of the ball both in the cup and bottom bearing, ⅛ in. holes are drilled to take wooden shear pins of such size that shear cannot take place until after the bearing faces come together. They protect the bearing faces from excessive scoring. Bearings were made in pairs, of cast iron, cold rolled steel and hardened tool steel, and a special method of polishing the bearings before and after testing is described. The spindle is driven by a variable speed motor.

Tests were run at a spindle speed of 500 r.p.m., giving a rubbing speed of 65 ft. per min. on the 0·2 in. bearing.

Bearings were run for 10 min. without weights in weight pan, then 1 lb. weights added at 5 min. intervals until maximum load was approached, when increments of 0·2 lb. were added at 1-min. intervals until seizure occurred. The oils used were S.A.E. No. 30 engine lubricants, and trials were made with paraffin base, asphalt base and Mid-Continent oils, and one containing a lubricating oil dope. The results show that lubricants of the same viscosity give different results when the oil film is loaded until rupture occurs, and also that bearing material is a large factor in the load-carrying capacity of a lubricant. Hardened tool steel bearings generally gave the lowest results and the least scoring and are therefore recommended for normal use. Results of check tests agree reasonably well, but the necessity for thorough cleansing of bearings after polishing is stressed. It was found that size of bearing does not affect the unit load-carrying capacity of the lubricant, but that rubbing speed is a very important factor in the rupture of the oil film. The machine offers opportunities for examining lubricants under a variety of test conditions. R. A. E.

1117. Apparatus for Finding Load Carrying Capacity of E.P. Lubricants. S. A. McKee, F. G. Bitner and T. R. McKee. *Nat. Petr. News*, 6.9.33, 25 (36), 21.—In some previously reported work, a number of E.P. lubricants were tested in four machines and it was found that (*a*) the four machines operated according to makers' instructions did not rate the lubricants in the same order as regards load-carrying capacity; (*b*) no set conditions could be found such that all machines would rate all the lubricants in the same

order; (c) no one machine rated the lubricants in the order of their service performance.

It was noted that the shape and action of the test surfaces in all these machines differed greatly from the shape and action of the teeth in the usual type of gearing, and also that the ratio of applied load to actual pressure changed rapidly during a test run.

The apparatus constructed consists essentially of two self-aligning steel rolls made of fine-grain nickel molybdenum steel, about 2 in. diameter and ½ in. wide, acting under load and mounted so that each could be driven independently at various speeds. Their working surfaces are true cylinders, but their bores are ground on a taper. The machine contains two interconnected sets of gears mounted on anti-friction bearings in individual oil-tight cases.

One of the gear boxes has a train of three gears with a fixed reduction of 4 to 1, and contains the main or high speed shaft of the machine, one end of which is connected to the variable speed mechanism, and the other end to one of the test rolls.

The second gear box is provided with a connection for driving the second test roll, and is constructed so that the gears are easily interchangeable.

The two rolls are on parallel axes, the second roll being directly beneath that mounted on the main shaft. Their points of contact can be made to travel in the same or in the reverse direction, by suitable manipulation of the gears.

The complete unit is supported by a knife edge and a V slot in a rectangular container holding about 1 quart of the lubricant, the level of which is at the approximate centre of the lower roll. The temperature of the lubricant is maintained at any desired level by electric heaters, and is recorded by a thermometer, while the temperature of the upper roll is obtained by a thermocouple in contact with the main shaft close to the roll.

Load is applied by means of a scale pan and weights or by a hand lever provided with a thumb latch and quadrant, a spring balance in this latter case indicating the load applied. A practically uniform rate of loading can be obtained by connecting the hand lever by means of a flexible steel cable to the tool carriage of a motor-driven lathe so located that the motion of the carriage is in line with the motion of the lever.

To carry out a test, the driving mechanism is set to the required speed, the lathe adjusted to the desired rate of loading, and the lubricant heated to the required temperature. The machine is run for about 30 sec. until the speed has become constant, and the load then applied at a constant rate until failure occurs, or the maximum load capacity of the machine is reached. Failure is detected by the scoring of the surface and by the fine spray of incandescent metal particles which accompanies it.

A table gives the loads at failure for the different lubricants tested. Good reproducibility is obtained, deviations from the mean being of the order of 2–3%. Graphs indicate the effect of rate of loading and temperature of the lubricant on the load at failure, and the behaviour of the different lubricants is observed to vary considerably.

In rating the lubricants with this machine, it is apparent that the overall performance of a given lubricant cannot be assessed by a single test under any one set of operating conditions. However, by means of a number of tests under varying conditions it is possible to place the lubricants tested in a definite order.

It is found that over the operating rate covered, this machine appears to rate the lubricants in reasonable agreement with ratings based upon service performance in automotive hypoid gears. D. L. S.

1118. Practical Viscosity-Temperature Coefficient for Oil Products. T. O. Bell and L. H. Sharp. *Oil & Gas J.*, 17.9.33, **32** (13), 13.—A viscosity-temperature coefficient system is described which is claimed to be superior to other systems in that it meets all of the following requirements: (*a*) It indicates change of viscosity with temperature; (*b*) it permits calculation of viscosity at any given temperature; (*c*) it is approximately additive so that the coefficient of a blend can be predicted from that of its components; (*d*) it is based on a generally accepted standard; (*e*) it eliminates arbitrary scales; and (*f*) its units are readily converted to units in general use.

The original viscosity coefficient from which the present system was developed was a measure of the slope of the viscosity-temperature line drawn on the Herschel chart which used arbitrary horizontal and vertical scales. By slightly revising the original data and using the A.S.T.M. standard chart, the present system has been worked out. A numerical value for the slope of the viscosity-temperature lines of any particular oil on the A.S.T.M. chart is obtained by superimposing on the chart two linear scales of any convenient units, one vertical H and one horizontal K. The value of the slope is then expressed as the tangent of the angle of the line with the horizontal. Thus

$$S = \frac{H^{1} - H^{11}}{K^{1} - K^{11}}$$

where H^{1} and K^{1} and H^{11} and K^{11} are the co-ordinates on the chosen scale of two points P^{1} and P^{11}

By arranging the horizontal scale on the chart so that 0·00 corresponds to 210° F. and 1·00 to 100° F. operation is further simplified, S being $= H_{100} - H_{210}$.

To obviate the necessity of using a chart with superimposed scales for determining the values of S or H_1 tables have been compiled giving the value H for each Saybolt viscosity from 35 to 100,000,000 secs. and the value K for each temperature from −30° F. to 450° F.

The use of the chart for indicating the origin of an oil is explained and a list given of the slope values of well-known basic oils. The slope value of blends of oils can be calculated, and by the use of the tables given and the formula quoted above, the viscosity at any temperature can be calculated from that at another temperature.

The original chart has also been reconstructed to include scale of slope values so that the viscosity temperature line can be determined when the slope and viscosity at only one temperature is known.

By using line co-ordinates a further chart has been designed, permitting the simultaneous representation of the viscosity temperature characteristics of a number of oils requiring only a single point for each oil. The use of the first table for blending purposes, for crankcase dilution calculations, plotting of viscosities versus other properties, and preparation of viscosity diagrams is explained. The relationship of the Dean and Davis viscosity index to the slope value of the present system is graphically illustrated, and the method whereby Table I. was developed is explained. C. L. G.

1119. Vapour-Liquid Equilibria of Hydrocarbon Mixtures. E. C. Bromiley and D. Quiggle. *Ind. Eng. Chem.*, 1933, **25**, 1136.—The work described was undertaken in order to find binary mixtures more suitable than benzene-toluene or benzene-carbon tetrachloride for testing the efficiencies of fractionating columns. Four binary and two ternary mixtures (N-heptane-toluene, toluene-N-octane, 2, 2, 4, trimethylpentane-N-octane, N-heptane-methylcyclohexane, N-heptane-methylcyclohexane-toluene, and N-heptane-methylcyclohexane-acetone) were investigated, using an equilibrium still devised

by Othmer, analyses of the equilibrium mixtures being effected by means of determinations of density and refractive index. Full data on the mixtures are given, and it is concluded that the two systems, N-heptane-toluene and toluene-N-octane, are well suited to the determinaton of efficiencies of fractionating columns, for the components differ in the first case by 12° and in the second by 16° C. The mixtures, moreover, are readily analysed by measurements of refractive index. W. H. T.

1120. Internal Friction of Miscible Liquid Mixtures. (1) Benzene-Alcohol-Water. (2) Paraffin Oils-Water and Acids or Alkalies. M. Pestemer and M. Birkmann. *Koll. Z.*, 1933, **65** (1), 25–31.—The internal friction of the liquid mixtures is determined by vigorous stirring at 800 r.p.m., and in the region of miscibility the friction increases as in emulsions to a maximum, which amounts to 40% of phenol and 24% of olive oil. Suitable acids or alkaline salts cause peptisation, which results in a decrease in the internal friction.

The internal friction of the systems benzol-alcohol-water have been determined under the given experimental conditions by determining the maxima in the binary systems ethyl alcohol-water and benzol-water. The friction increases to a maximum in the ternary system of 10% of alcohol, 55% of benzol and 35% of water. Several curves are given, showing the relationship between the percentage of benzol or paraffin oil and the internal friction expressed as absolute viscosity. W. S. E. C.

1121. Measurement of Gas Currents in the Laboratory. C. Padovani and G. Monti. *Giorn. Chim. Ind. Appl.*, 1933, **15**, 331.—A summary is given of the principles and the apparatus which have been used for measuring gas currents and certain disadvantages are discussed. Particular reference is made to the capillary flow-meters of the Riesenfeld type, which, it is stated, only obey the linear law of Poiseuille between narrow limits. After experimenting with the passage of gases through porous walls (filter-paper, porous glass, graphite and porous refractory material), the authors found that many of these materials behaved exactly as capillary systems and that the flow of gas through them obeys Poiseuille's law between very wide limits. Flow-meters have therefore been constructed in which a porous diaphragm or membrane is substituted for the single capillary. The construction of a flow-meter for use at normal pressures is described and illustrated, in which a membrane of special Jena filtering glass was sealed into a tube connected across a manometer in the usual way. Comparative curves are given for carbon dioxide, air and hydrogen for this flow-meter and one of the Riesenfeld type, showing litres per hour of gas passed for increasing manometer pressures. The new type gives linear curves over a much wider range.

A similar apparatus, made of metal, is illustrated for measuring gases under pressure. C. C.

1122. Testing of Ductility as Technical Method of Examination in the Bitumen Industry. W. Rodiger. *Koll. Z.*, 1933, **65**, 11–20.—The property of ductility is now recognised as due to a particular state of matter, and not associated with particular substances. Investigators have studied the correlation of ductility with other physical properties, as, for instance, Tammann and Tampke (temperature and rate of drawing of the thread, viscosity and surface tension); Fano, Aggazzotti and Jochims. No success was obtained, although it soon became clear that the presence of a fibrillar structure was of importance.

In various industries practical tests of ductility have been worked out, and particularly in the bitumen industry, two test methods have been in use for some time. These two methods are, "The thread-length in the Ubbelohde drop-point" and the Dow method of ductility measurement.

The Ubbelohde method consists in determining the temperature at which a quantity of bitumen drops under its own weight. The falling drop does not break off sharply, but draws out a thread of greater or less length. The length of thread at the breaking point is measured.

Results show considerable variation, *i.e.*, from 5 to 30 cm. Bitumens giving less than 10 cm. length must be used with caution, while those with over 20 cm. are to be preferred. As a criterion $>$ 18 cm. is taken.

In the Dow method, the length of thread is determined in the plastic condition, at a definite constant temperature. The usual temperature is 25° C., but measurements at 0° C. or 10° C. are sometimes made. For bitumens of medium softness, with a drop point between 50–70° C., the ductility at 25° C. should be more than 100 cm.

Mexican asphaltic bitumen gives much the best results, while Rumanian asphaltic bitumens are not so good, and the Polish and Russian materials (paraffin base) are the least satisfactory. There are great differences of ductility even for asphaltic bitumens of the same penetration.

The paraffin content is often supposed to be the cause of low ductility, but this cannot be sustained in face of experimental evidence. The method of distillation of the crude oil has a great influence.

Study of the variation of ductility with temperature is of importance in judging the suitability of bitumens for road work, while the method has also been used for characterising tar-bitumen mixtures. The flocculated mixtures show minima on the curve of ductility plotted against composition of the mixture. L. G. G.

1123. Viscosity of Emulsions. E. G. Richardson. *Koll. Z.*, 1933, **65**, 32–37.—The emulsions used consisted of benzene-in-water, emulsified with sodium oleate, and water-in-benzene, magnesium oleate being added to the benzene. The emulsions were made by intermittent shaking, followed by homogenisation by the Briggs method.

The viscosities were measured in a Couette concentric cylinder apparatus. The torsion may be measured by the deflection of a pointer, or by a null method.

The curves of viscosity against rate of shear show greater departure from the straight line, as the concentration of disperse phase increases. The apparent viscosity decreases as the rate of shear increases. The very concentrated emulsions show plasticity (yield value, below which no movement of the inner cylinder results).

An apparatus is described to demonstrate whether slip occurs at the interface of the two liquids. The results were negative, but Bond found evidence of slip in the case of one liquid dispersed in another.

Formulæ for the concentration-viscosity function in disperse systems are discussed, and the interpolation of a factor by which the 2·5 in the Einstein formula must be multiplied to render it applicable to emulsions is advocated. Where the disperse particles are sufficiently small, however, they behave as if undeformable and the factor is not necessary. The critical radius is about 0·5 cm., so that the original Einstein formula may be used for emulsions if the mutual influence of the particles is neglected. By suitable choice of constants most of the other formulæ proposed may be applied.

The author derives the formula

$$\log \cdot \frac{\eta}{\eta_0} = K \phi$$

(the symbols have their usual significance), but points out that it is not possible to differentiate sharply between the various formulæ proposed as they are mostly nearly equivalent. L. G. G.

1124. Ignition of Gases. Part VIII. C. A. Naylor and R. V. Wheeler. *J.C.S.*, 1933,1240–1247.—(*a*) *Mixtures of Ethane, Propane or Butane with Air.*—With apparatus previously described (*J.C.S.*, 1921, 2456) the relative ignition temperatures for series of mixtures with air of ethane (1–11%), propane (1–12%) and n-butane (1–10%) have been determined. Two sizes of quartz reaction vessels were used, and the values of the ignition temperatures found vary from about 600° C. to 440° C. The reactions occurring prior to ignition, *i.e.*, during a "lag" period, are somewhat akin to those obtained when methane is so ignited, but important differences are found. These differences have been explained by experiments whereby samples of ethane and air were withdrawn during the lag period and analysed. For example, it appears that the higher paraffins are first thermally decomposed to give, amongst other things, the corresponding olefins, which have ignition temperatures some 15–25° C. lower than the corresponding paraffins. Hence an increased concentration of the ethane in an ethane-air mixture will favour a lower ignition temperature. With methane, however, which is thermally stable at these temperatures, no such effect will be observed, and it is found that methane-air mixtures ignite more readily with an increased concentration of oxygen. The experiments indicate that the reactions are not isothermal and generally unlike chain reactions; in fact, they appear to be thermal reactions. In none of the experiments could acetaldehyde be detected during the "lag" period. The authors record the effects of traces of iodine, ethyl iodide, etc., and also the effects caused by addition, at the outset, of small amounts of the products of oxidation, viz., formaldehyde and carbon monoxide. With ethane, such oxidation products had no appreciable effect on the ignition lag.

(*b*) *Mixtures of Ethylene, Propylene or Butylene with Air.*—The ignition temperatures of these gases are from 15–25° C. below those of the corresponding paraffins. The lags at the ignition temperatures are shorter with ethylene or butylene, but longer with propylene, than the lags obtained with the paraffins. The reactions in the lag period are thermal reactions over the range 600–750° C., catalysed by the products of an initial slow and flameless combustion. Decomposition is the first step in the oxidation, but oxidation may be simultaneous, since formaldehyde is produced in considerable amount in the pre-flame period.

Peroxides, however, could not be detected. The experiments of the authors lead to the conclusion that the most important reaction leading to the production of flame with the olefin-air mixtures, is the oxidation of the olefin to an aldehyde. W. E. J. B.

1125. Relation between the Constitution and Knock of Hydrocarbons. F. Hofmann, K. Berlin and Schmidt, A.W. *Bren. Chem.*, 1933, **14**, 326–328.—In an earlier investigation it was found that the polymerisation products of cyclopentadiene and of styrene shower a higher anti-knock value than the hydrocarbons themselves. The investigation has been extended to other polymerised hydrocarbons and their monomers. Expressing the results by the compression ratio at which pronounced knock occurred and also in octane numbers, the following results were secured:—

Butadiene	C.R. 1/6·23	O.N. 83/84
„ dimeric, freshly dist.	1/5·23	60/61
„ „ old	1/5·00	56
Cyclohexane, freshly dist.		70/71
„ dimeric, freshly dist.	1/4·95	53/54
„ „ old	1/4·95	53/54

Two polymerised ethylenes were also tested:—

Ethylene 1 .. B.P. 140–210° C.	Mol. wt. 123	C.R. 1/4·86	O.N. 50/51
„ 2 .. 210–265° C.	272	1/4·79	47/48

Tetrahydro and decahydronaphthalene yielded octane numbers of 65 and 50 respectively, ethyl alcohol 83, and methylcyclopentane and cyclopentane each 59/60.

A diagram showing the structural formulæ and knock value of the more important hydrocarbons is given, and the preparation and properties of the hydrocarbons used is described. B. C. A.

1126. Knock-Rating of Heptine—1. A. R. Bowen, A. W. Nash and F. H. Garner. *Nature*, 1933, **131**, 410–411.—Collected data on the knock-ratings of pure paraffin, naphthene unsaturated naphthene, aromatic and olefine hydrocarbons, have recently been published, and it was desired to obtain similar information on an acetylene hydrocarbon.

Heptine—1 was prepared by the action of sodamide on 1 : 1 : dichloroheptane, and was obtained in a 33% yield with the following properties. B.P. between 98 and 101° C. at 750 mms., sp. gr. at 15° C./4° 0·727, refractive index 1·4093.

Its knock-rating was determined in a 20% vol. blend with standard spirit in a 8.30 engine with a jacket temperature of 100° C., and the blending octane number of the hydrocarbon was found to be 79·5.

A table is given comparing the knock-rating of heptine—1 with representative seven carbon atom hydrocarbons of other series. It appears that the introduction of a double bond into the heptane molecule in the α position increases the octane number considerably, and that the further introduction of a treble bond in the same position further increases this value though not to so great an extent. D. L. S.

1127. Knocking Characteristics of Naphthene Hydrocarbons. W. G. Lovell, J. M. Campbell and T. A. Boyd. *Ind. Eng. Chem.*, 1933, **25**, 1107.—The relative knocking tendencies of 69 naphthene hydrocarbons have been assessed, the measurements being made on the hydrocarbons in admixture with gasoline and expressed by using the anti-knock effect of aniline as the standard of comparison. It is shown that considerable differences exist between the knocking properties of the compounds and also between the isomers. Relationship is consistent not only between structure and tendency to knock and also with that found previously for paraffin and aliphatic olefin hydrocarbons. For simple hydrocarbons, anti-knock quality decreases as the ring size increases, and compounds with a ring structure have higher anti-knock values than normal paraffins of the same number of carbon atoms. Increasing the length of the longest unbranched side-chain of the hydrocarbon results in a very consistent decrease in the aniline equivalent. This relationship is apparently fundamental, since it is observed with paraffins, olefins and alkyl naphthenes. Position isomerism is not a very important factor and it is possible that small differences in this respect are masked by experimental errors. Changes in the structure of the side-chain bring about considerable alteration of aniline equivalent, the more compact space arrangement of structural formula giving large increases. In general, the distribution of the side-chain carbon atoms into a greater number of shorter chains gives a greater increase than redistribution of the atoms among several different side-chains. Comparing paraffins and naphthenes having the same number of carbon atoms, it appears that the latter lie within the range of anti-knock quality established by the paraffins, but that on the whole, the range covered by both types of hydrocarbons seems to be approximately the same. The effect of the removal of hydrogen from the saturated cyclic compounds is, in general, to increase the aniline equivalent considerably. For the compounds studied in the cyclohexane series, there is a considerable

increase in aniline equivalent when a methyl group is added to cyclohexane, although this is not true for the corresponding saturated compounds.
W. H. T.

1128. Nitrogen Compounds in Petroleum Distillates. *IV. Isolation of* 2-4-8 *Trimethylquinoline.* T. S. Perrin and J. R. Bailey. *J.A.C.S.*, 1933, **55**, 4136–4140.—Bases in kerosine distillates represent a complex mixture of both aromatic and non-aromatic types in a percentage ratio of approximately 15 to 85 respectively. The isolation of such bases in a pure form by the fractional crystallisation of their salts is possible in only exceptional cases. Particularly is this so for the non-aromatic bases. A satisfactory method, known as "Cumulative Extraction," has been developed, however, to separate such bases, as follows: The bases are dissolved in an excess of 1 : 1 hydrochloric acid, and the solution extracted with an equal volume of chloroform. (Ethylene chloride may be used, if desired.) The initial chloroform extraction effects a high concentration of the aromatic hydrochlorides in the aqueous layer, and of the non-aromatic hydrochlorides in the chloroform layer. The water layer is then extracted several times with chloroform and the chloroform layer with water. Refractive index measurements offer a convenient control of the process.

In the final separation of the aromatic bases from small amounts of non-aromatics, either the free bases or their hydrochlorides can be converted in acetone solution to sulphates. The aromatic sulphates mainly separate in crystalline form, the non-aromatics remaining dissolved.

By the above means 2-4-8 trimethylquinoline has been extracted from the kerosine distillation fraction (around 275° C.). This base has b.p. 280° (corr.) at 746 mm. and n_D^{20} 1·5855. Search for the common coal tar bases, quinoline, isoquinoline, etc., gave negative results, but a second base of composition, $C_{12}H_{13}N$, and unknown structure was isolated.

V. The Use of Sulphur Dioxide in the Separation of Petroleum Bases. B. S. Biggs and J. R. Bailey. Ibid., 4141–4142.—The additive reaction of sulphur dioxide on amines has been applied to the isolation of 2-3 and 2-4 dimethyl quinoline from a distillation fraction of kerosine bases in the range 263–267° C. The use of this method is unsatisfactory, since quantitative separation is not obtained.

VI. Occurrence of 2.8 *Dimethyl Quinoline in Kerosine Distillate of Californian Petroleum.* G. R. Lake and J. R. Bailey. Ibid., 4143–4145.—The Cumulative Extraction method on the 253–256° C. fraction of the kerosine bases has led to the isolation of 2-8 dimethylquinoline, m.p. 24° C., b.p. 252·4° C. (754 mm.), n_D^{25} 1·5997. The phthalone and various other salts were prepared.

VII. New Reactions of the Naphthenic Base $C_{16}H_{25}N$. *A New Naphthenic Base* $C_{19}H_{31}N$. B. F. Armendt and J. R. Bailey. Ibid., 4145–4149.—It has not been possible to hydrogenate either of the above and they also resist dehydrogenation, a stability hardly to be expected of true hydro-aromatic bases. Prolonged heating with alkaline permanganate has no oxidising effect. An unexpected observation was that the $C_{16}H_{25}N$ base, condensed readily with phthalic anhydride to produce a phthalone, whereas the $C_{13}H_{21}N$ base did not. Structural formulæ have been assigned to both bases, provisionally.
W. E. J. B.

1129. Rapid Iodine Value Method in the Valuation of Motor Benzole. E. Galle and R. Klatt. *Brenn.-Chem.*, 1933, **14**, 321–326.—Five crude benzoles of varying origin were refined to motor benzole by a variety of methods. The product obtained was tested with regard to acidity, colour, gravity and

iodine value before and after distillation where applicable, and the refining loss recorded.

The determination of the iodine value was made according to the rapid method, which consists of weighing 0·09–0·11 gm. of benzole into 10 ml. of 96% alcohol contained in a 500 ml. flask, furnished with a ground stopper. The benzol goes to a clear solution in the case of distilled benzoles, and to an emulsion for undistilled, both conditions being favourable for the determination of the iodine value. 25 ml. of 0·2 N alcoholic iodine solution are then added and 200 ml. of distilled water and the mixture gently agitated. The solution is allowed to stand for five minutes and the excess iodine titrated with thiosulphate.

The methods of refining employed were: (1) 96% sulphuric acid, followed by distillation to 5% bottoms to remove polymers. (2) A modified process using sulphuric acid, wherein after shaking with the percentage volume under investigation for two minutes only, the acid was diluted with distilled water to a concentration of 39–40° Be, and the shaking continued for three minutes longer, and then as usual. (3) Using sulphuric with the addition of boric acid, then as before. (4) Sulphuric acid followed by doctor treatment. (5) Aluminium chloride on the water bath. (6) Vapour phase treatment with zinc chloride. (7) Vapour phase treatment with silica gel.

Detailed experimental results are recorded in a series of tables, and the change in iodine number is traced by means of graphs, showing iodine number against the per cent. of refining agent used, the iodine number diminishing with increasing refining.

The authors conclude that the rapid iodine method permits of the determination of the quantity of unsaturated hydrocarbons remaining in benzole after the various processes of refining, that it is more adapted for this purpose than the determination of other halogen numbers, and that although a perfect agreement between iodine value and other tests for the evaluation of refining cannot always be found, this value, as estimated by the quick method, is still of value for following refining effects. B. C. A.

1130. Hexamethylethane. F. C. Whitmore, C. J. Stehman and J. M. Herndon. *J.A.C.S.*, 1933, **55**, 3807–3809.—Hexamethylethane has been prepared by two methods which give satisfactory results. By the action of pentamethylethyl bromide on dimethylzinc, a 50% yield of the hydrocarbon was obtained. Tertiary butylmagnesium chloride and silver bromide gave yields of about 20%. The hydrocarbon melts at 101° C. E. B. E.

1131. Formation of Olefines from Tertiary-Butylmethyl Carbonil. F. C. Whitmore and P. L. Meunier. *J.A.C.S.*, 1933, **55**, 3721–2.—Tertiary-butylmethylcarbinol (pinacolyl alcohol) has been dehydrated over a phosphoric acid-silica gel catalyst and in addition to the usual (rearranged) olefines, tetramethylethylene and unsym-methylisopropylethylene, a small amount of the normal dehydration product, tertiary-butylethylene, was obtained. E. B. E.

1132. Preparation of Tetramethylmethane. F. C. Whitmore and G. H. Fleming. *J.A.C.S.*, 1933, **55**, 3803–3806.—The most satisfactory method of preparation of this hydrocarbon, which has been isolated from petroleum by Markownikoff and by Poni, was found to be by the action of tertiary butyl chloride on methylmagnesium chloride. Yields of from 42 to 50% were obtained.

The hydrocarbon has the following properties: $d_{0°}^{0°}$ 0.613; b. pt. 9·4°/760 mm.; f. pt., −19·5° C.; $n_D^{0°}$ 1·3513. E. B. E.

1133. Preparation of Pure 1-Butene and Isobutene. H. Pines. *J.A.C.S.*, 1933, **55**, 3892–3893.—The author's previous results are not in agreement with the recent statement of Matignon, Moureu and Dode (Compt. rend., 1933, **196**, 973) that 85% 1-butene and 15% 2-butene are obtained by the dehydration of n-butyl alcohol with aluminia. On the contrary, 100% pure 1-butene and 2-butene may be obtained by passing the appropriate butyl alcohol over alumina at 375° to 475° C.

Matignon's, etc., results are attributed to the fact that the product was analysed by conversion to dibromide and fractionation of this, a method which is stated to be unsatisfactory. E. B. E.

1134. Isolation of Benzene from Shukoko Crude Oil. M. Mizuta. *J. Soc. Chem. Ind.*, Japan, 1933, **36**, 448B.—It has been found difficult to isolate benzene in a pure state by distillation from Shukoko gasoline owing to the formation of azeotropic mixtures. Isolation of benzene by freezing necessitates a knowledge of the extent to which it should be concentrated in the gasoline. This was determined by adding various proportions of chemically pure benzene to aromatic-free Shukoko gasoline and determining the freezing points of the solutions. It was found that the freezing point was lowered in proportion to the amount of gasoline added until a 50% mixture was reached, after which it was lowered more rapidly by the addition of gasoline. Thus, in order to isolate benzene by freezing, it must first be concentrated to over 50% by distillation. After freezing out the benzene, the latter was found to contain 10% of gasoline, and hence required a further fractionation. Determinations of the physical constants of the benzene finally obtained confirmed that it was identical with that prepared synthetically or from coal tar. W. H. T.

1135. Formation of Olefines from Tertiary Alcohols containing a Neopentyl Group. F. C. Whitmore and K. C. Laughlin. *J.A.C.S.*, 1933, **55**, 3732–3738.—Three alcohols of this series were dehydrated with β-naphthalene sulphonic acid, and the olefines produced separated and studied. Tertiary alcohols containing the neopentyl group show a tendency, in contrast to the primary and secondary compounds, to dehydrate to olefines without rearrangement; in none of the cases studied was the rearrangement greater than 25%. E. B. E.

1136. Polymerisation of Isoprene. C. A. Thomas and W. H. Carmody. *J.A.C.S.*, 1933, **55**, 3854–3856.—The polymerisation of isoprene in the presence of aluminium chloride has been studied. Pure isoprene reacts very slowly, but the reaction is accelerated by the addition of hydrogen chloride gas, pentene-2, etc. The hydrogen chloride reacts to form isoprene hydrochloride, which forms a complex with aluminium chloride, which is soluble in isoprene. Pentene-2 forms a similar complex.

The more of the aluminium chloride which is brought into solution the larger proportion of polymer soluble in hydrocarbon is formed and the less of the insoluble form. These two polymers differ only in molecular weight, the elementary composition being the same. E. B. E.

1137. Preparation of Dimethylpentenes. J. C. Whitmore and A. H. Homeyer. *J.A.C.S.*, 1933, **55**, 4194–4196.—By the dehydration of 4, 4-dimethylpentanol-2 with sulphuric acid, an 82% yield of olefines was obtained. Rearrangement does not occur.

From the properties of the product it was calculated to consist of 82% of 4, 4-dimethylpentene-2 and 18% of 4, 4-dimethylpentene-1. E. B. E.

1138. Olefines from Di-Tert-Butylcarbinol. F. C. Whitmore and E. E. Stahly. *J. A.C.S.*, 1933, **55**, 4153–4157.—Di-tert-butylcarbinol or dehydration with 1-chloro-4-naphthalene sulphonic acid at 180-200° C. gives a 77% of trimethylethylene. Gas is evolved, consisting mainly of isobutylene, and some polyneers are formed.

If the dehydration is carried out below 155° C. a mixture of nonenes is obtained. The mechanism of decomposition of the nonenes into trimethylethylene and other hydrocarbons is discussed, and an explanation put forward based on electronic considerations. E. B. E.

1139. Thermal Decomposition of Lead Tetraphenyl. M. F. Dull and J. H. Simons. *J. A.C.S.*, 1933, **55**, 4328–4329.—It has been found that, contrary to the statements of Zartman and Adkins, a quantitative yield of diphenyl can be obtained from the thermal decomposition of lead tetraphenyl without the presence of hydrogen or of a catalyst. The lead tetraphenyl (a white solid, m. pt. 223° C.) was decomposed in pyrex glass bulbs. At 252° C. a 100% yield of diphenyl was obtained. At higher temperatures, p-diphenylbenzene and benzene were obtained. The temperature of 252° C. was the lowest at which observable decomposition took place. The lead deposit at this temperature was bright, but at higher temperatures more or less charring occurred. E. B. E.

1140. Oxidation of Paraffin and Ceresin by Atmospheric Oxygen at High Temperatures. St. Reiner. *Erdöl u. Teer*, 1933, **9**, 412.—Ceresin consists of paraffin with 0-30% of refined ozokerite, according to the prevalent price-levels. The melting point and acid number of ceresin are higher than for paraffin. The latter value varies between 0·03 and 0·15%. The iodine number of these products is chiefly due to small quantities of unsaturated oily constituents. Paraffin from petroleum has an iodine number of 0·5 to 1·9, while that from brown coal tar varies from 3·5 to 5·8.

Experiments were carried out on ceresin and paraffin by heating in air at 80° C., 120° C. and 140° C., the oxidation being followed by acid number determinations. Little change occurred in either material after 170 hours heating at 80° C. At the higher temperatures paraffin is the more easily oxidised. For instance, after 90 hours at 140° C., paraffin shows an acid value of 5·0 as against only 2·3 for ceresin. The mechanism of the oxidation process is briefly discussed. E. B. E.

1141. Bromination of Saturated Aliphatic Hydrocarbon Gases. W. J. Perelis. *Ind. Eng. Chem.*, 1933, **25**, 1160.—Halogenation of the gaseous aliphatic hydrocarbons has been considered by the author as the preliminary step in the manufacture of alcohols and other chemical compounds. The method worked out for bromination was as follows: the dried gas was bubbled through a layer of dried liquid bromine and a sufficiently high bromine layer was used to produce a saturated bromine solution in the gas. The operating temperature was varied according to the products desired.

Using commercial products the following compounds were isolated: methyl bromide, methylene bromide, ethyl bromide, ethylene bromide, ethylidene bromide, *n*-propyl bromide, *sec*-propyl bromide, *n*-butyl bromide and *sec*-butyl bromide.

A sufficiently low bromine concentration in the mixture of an aliphatic saturated hydrocarbon gas and bromine vapour gave the pure monobromides when heated in the presence of an iron catalyst. Thus, a bromine concentration of 6·6% gave pure butyl bromide. Increased concentrations of the bromine led to the formation of a mixture of bromine substitution products. The conclusion was drawn that up to a certain point of bromine concentration

the affinity of bromine was greater towards hydrocarbons than towards brominated hydrocarbons.

A drawing of the apparatus is given. Approximately 1·5 litre of gas per hour were used and the gas-bromine vapour was heated in the presence of an iron-powder catalyst. E. N. H.

1142. Polymerisation and Explosive Decomposition of Ethylene under Pressure. G. Egloff and R. E. Schaad. *J. Inst. Petr. Techn.*, 1933, **19**, 800–811.—An account of experiments on the polymerisation of ethylene under a variety of conditions and of an examination of the products obtained. G. R. N.

1143. Catalytic High Pressure Hydrogenation of Aromatic Hydrocarbons and Catalytic High Pressure Destruction of the Corresponding Hydrogenated Products: II. Mesitylene; III. Hexamethylbenzene. A. Dros, A. J. Tulleners and H. I. Waterman. *J. Inst. Petr. Techn.*, 1933, **19**, 784–799.—An account of experiments on (i.) the preparation then hydrogenation of mesitylene and hexamethylbenzene, using nickel as a catalyst; and (ii.) the destructive hydrogenation of hexahydromesitylene and hexamethylcyclohexane. G. R. N.

1144. Hydrogenation of Aromatic Compounds. V. Ipatieff. *J.A.C.S.*, 1933, **55**, 3696–3701.—Experiments have been carried out on the hydrogenation of benzene, toluene, xylene, naphthalene and phenol in the presence of molybdenum, nickel, copper, aluminium and iron oxide catalysts at temperatures in the neighbourhood of 450° C. and hydrogen pressures of 65 to 100 atmospheres.

It was found that monocyclic aromatic hydrocarbons could not be hydrogenated with molybdenum or molybdenum-aluminium catalysts. Xylene, under the same conditions broke down, giving benzene and toluene.

Naphthalene is hydrogenated to tetralin, if the temperature does not exceed about 450°, but above this temperature decomposition occurs, giving benzene, toluene, etc., and naphthenes such as cyclohexane and methylcyclopentane, depending on the catalyst and conditions. The rate of hydrogenation is not affected by the presence of thiophene.

In the case of phenol, hydrogenation occurs in the presence of various catalysts. Naphthenes, especially cyclohexane, are usually obtained besides benzene, the hydrogenation of the aromatic nucleus being explained by the keto-enol tautomerism of phenol. The presence of thiophene decreases the yield of hydrocarbons; a small amount of phenyl ether and cyclohexylcyclohexanol are formed in this case. (Table II. is stated to contain the results of both the naphthalene and phenol experiments. Actually it contains the latter only, the former not being given.) E. B. E.

1145. Thermal Dehydrogenation of Paraffin Hydrocarbons. F. O. Rice and M. D. Dooley. *J.A.C.S.*, 1933, **55**, 4245–4247.—It has been shown that the thermal decomposition of ethane in the region of 900° C. involves the formation of free methyl radicles. Either the formation of ethylene and hydrogen proceeds by a free radicle mechanism or else the two reactions occur side by side. The formation of free methyl radicles was proved by making use of the Paneth effect on mirrors of metallic antimony. E. B. E.

1146. Thermal Decomposition and Hydrogenation of Organic Compounds. E. Audibert. *Ann. des Comb. Liq.*, 1933, **8**, 565–605.—This paper is a continuation of a series of informative lectures (see Abstr. 1027). It deals first with the thermal decomposition of the various classes of hydrocarbons, followed by a description of Berthelot's method of hydrogenation. Finally the work of Sebatier is summarised, and the application of his results discussed. C. C.

1147. Testing of Fuels, Solvents and the like for Corrosive Sulphur by means of Copper. H. Kiemstedt. *Brenn. Chem.*, 1933, **14**, 284–286.—The use of copper in the testing for corrosive sulphur is claimed to be better adapted to practical requirements than the mercury shaking test, as in addition to reacting with elementary sulphur, copper reacts with hydrogen sulphide and in the presence of free sulphur also with mercaptan sulphur.

The technique of existing copper strip tests has been developed, and a new test devised which serves both to detect the presence of corrosive sulphur and to give an approximate estimate of the quantity thereof. The test consists of (essentially) heating a copper strip in the liquid to be tested under certain conditions, so that the decomposition of harmless sulphur compounds is avoided, and the formation of a comparable corrosion film is accomplished, this film being subsequently compared with films of known value.

In carrying out the test, copper strips 1 by 5 cm. are placed vertically in 10 ml. of the liquid contained in a cylindrical vessel, which in turn is partially immersed in a bath containing a heating medium of suitable boiling point, for the maintenance of a reaction temperature of 75° to 85° C., for which purpose carbon tetrachloride and trichlorethylene are very suitable. The period of heating is three hours.

Under these conditions sulphur contents between the limits of 1 and 5 mgm. per 100 cc. may be adequately estimated by comparison of the corroded strips, with selected artificially corroded strips, each of which corresponds to a known sulphur content, and in the preparation of which the action of free sulphur and the interaction of free and mercaptan sulphur has been taken into account.

At higher sulphur concentrations the corrosion layer is precipitated very densely or scales off, rendering comparison impossible. In this case the liquid is diluted with a suitable quantity of an inert solvent, for example pure benzol.

The presence of mercaptan sulphur co-existent with free sulphur is, so long as the sulphur content is not too high, usually recognisable by the speckled appearance of the corrosion layer. Non-corrosion of the copper strip does not constitute proof that corrosive sulphur is absent, as peroxides may be present, and adversely affect the reaction between copper and sulphur. If a positive test for peroxides is obtained, say, by shaking with potassium iodide solution, the copper strip test is repeated in the presence of a small quantity of a suitable reducing agent, such as hydroquinone, aniline, etc., whereby the disturbing influence of the peroxides is eliminated. B. C. A.

1148. Effect of Metallic (Lead) Dope on the Carbonisation of Oil in the Combustion Space of an Engine. R. O. King. *Engineering*, 1933, **136**, 183–186.—It has been shown that while oxidation activity is maintained, mineral oils of particular oxidation characteristics become possessed of the property of "oiliness," which is generally considered to be a special attribute of the "fixed" or fatty oils (see Abstr. No. 422, 1933). In certain parts (piston) of engines, especially the air-cooled types, the prevailing temperatures carry oxidation or decomposition to the late stage to form hard carbonaceous products which increase piston friction so that seizure may take place. A control of this oxidation in the direction of delay in the formation of carbonaceous products is achieved by the addition of small amounts of lead tetraethyl to lubricating oils.

The experimental work described lead to these conclusions: (1) Under various conditions of treatment (aeration under heat over varying periods of time) an appreciable proportion of the 1% of added tetraethyl lead (as ethyl fluid) remains in the oil. A new X-ray method for obtaining shadowgraphs of oil samples was employed to follow the variation of dope content.

(2) Journal-bearing lubrication tests performed in oxidation conditions indicated that the coefficient of friction at 40° C. increased with time (due to increase in viscosity of the oil, at 100° C. the beneficial effects of oxidation nearly balance the viscosity increase, whereas at 150° C. the oxidation effect predominates in that the coefficient of friction decreases as the period of circulation and air-blowing increases. Similar tests conducted with the same oil containing 12 ml. of ethyl fluid per gallon demonstrated the ability of the dope to prevent formation of carbonaceous products by oxidation, the coefficient of friction at 40° C. remaining constant over the 70-hour period of air blowing and circulation at 150° C. (3) Oxidation experiments were conducted in hot glass tubes (at temperatures up to 440° C.) in which air was drawn past asbestos wads soaked with oil containing various amounts of dope. The undoped oil gave rise to hard carbonaceous deposits in the hottest zones. The tubes corresponding to oil containing 1% and 2% of dope were as clear and free from oil oxidation products as the tube carrying air only. (4) Several road trials on a two-stroke air-cooled engine driving a motor cycle showed that the oil containing 1% of dope preserved reasonable freedom of the piston rings which were usually stuck in their grooves, and heavily scored when undoped oil was employed in the engine. The residual oil in the sump was invariably clean when doped before use. These results were confirmed substantially by bench trials with a 4-stroke engine.

C. I. K.

1149. Determination of Ethyl Alcohol in Gasoline Alcohol Mixtures. F. S. Mortimer and E. H. Giese. *Ind. Eng. Chem.*, Anal., 1933, **5**, 356.—The following is the method suggested by the authors: Gasoline mixtures of known alcohol content are shaken thoroughly with distilled water. The water layer is drawn off and the refractive index determined at 20° C. by means of the Zeiss immersion refractometer. Using the figures obtained a graph may be drawn from which the per cent. of ethyl alcohol present in an unknown mixture can be read directly. R. E. D.

1150. Mineral Oils in Drying Oils. *Anon. Chem. Trade J.*, 1.9.33, 93, 152.—The presence of mineral oil in drying oils may be determined by means of a small microscope of 20/30 mag. The method is based on the fact that whilst mineral oils mix with non-oxidised oils in all proportions, the solvent power of oxidised oils for hydrocarbons is considerably reduced. A mixture of linseed oil and mineral oil on exposure to the air, will show the separation of mineral oil droplets which can be seen under the microscope. When a small percentage of mineral oil is present, oxidation has to be well advanced for separation to be noted. A cobalt drier is added to the linseed oil under test, and this is left to oxidise for at least a day. The presence of 2% light oil or 1% heavy machine oil may be detected in linseed oil or in paints mixed therewith by this method. The thickness of the film or paint coating under test must not exceed a certain limit or hydrocarbons diffuse from the more oxidised layer into the lower, where they are more soluble, rendering detection impossible. The limiting thickness for cobalt varnishes is 15/25 microns. Moistening of the film by breathing on it increases sensitivity of the test and is indispensable when testing oil paints. R. A. E.

1151. Wetting Experiments with Hydrophile and Hydrophobe Powders on a System of Two Mutually Immiscible Liquids. III. E. Berl and B. Schmitt. *Koll Z.*, 1933, 65, 93–100.—In the first two articles the case of a single powder was dealt with; the present paper deals with conditions under which a mixture of two powders may be separated by shaking with a mixture of two mutually immiscible liquids.

The various possibilities as regards distribution of the powders between the two liquids and the interface, are discussed. The two important cases are :—

1. One powder in the aqueous liquid ; the other in the interface.

2. One powder in the non-aqueous liquid ; the other in the interface.

Methods are given for increasing the differential wetting of the two powders, as regards the non-aqueous liquid. The wetting of one powder by the non-aqueous liquid may be increased by addition of an activating substance, or may be decreased by a repressive agent.

A pair of powders with large differential wettability consists of quartz and charcoal. This mixture may be separated by shaking with a benzene-water mixture.

Examples of the effect of dyestuffs on the wetting properties of quartz powder are given. Crystal violet in 0·01% solution will transfer quartz from the aqueous phase to the benzene-water interface, while " Tuchrot-C " forces marble powder out of the aqueous into the non-aqueous liquid.

Under the heading of separation reactions requiring addition agents, the case of lead glance, zinc blend mixtures is discussed. Modifying agents such as aniline, toluidine and creosote are employed in conjunction with collectors, such as sodium carbonate, or cyanide, and the various combinations of these reagents are studied.

Potassium xanthogenate and its use in separating lead and zinc compounds is dealt with, as also its application to powders of mercury compounds. In the case of zinc blend—marble mixtures, the addition of copper sulphate is necessary before the xanthogenate is effective. The theory underlying this phenomenon is stated in terms of the adsorption of copper ions by the zinc blend. L. G. G.

1152. Conversion of Fatty and Waxy Substances into Petroleum Hydrocarbons. W. F. Seyer. *J. Inst. Petr. Techn.*, 1933, **19**, 773–783.—An interpretation of the literature on the chemical changes that can be imposed on fatty and waxy substances and their bearing on the origin and composition of petroleum. G. R. N.

1153. Benzoyl Hydrogen Peroxide. B. T. Brooks and W. B. Brooks. *J. A.C.S.*, 1933, **55**, 4309–4311.—Benzoyl hydrogen peroxide has been found to be a valuable agent for investigation of the structure of petroleum olefines ; it has the advantage over ozone, for this purpose, of being more easily prepared in quantity. The reagent has also been found useful in the determination of olefines in cases where presence of sulphur renders hydrogenation difficult, and where determination of iodine or bromine numbers is unreliable.

The method used for the preparation of the reagent consists in adding benzoyl chloride to a solution of sodium peroxide in ice-water, during agitation. After further agitation and filtration the sodium salt (sodium perbenzoate) is obtained. This is dissolved in more ice-water (solubility 132 grs. per litre at 0° C.) decomposed with sulphuric acid, and finally extracted with chloroform. The splitting of dibenzoyl peroxide by aqueous sodium peroxide gives two molecules of sodium benzoyl peroxide. Some benzoyl peroxide is obtained as a by-product. The yield of perbenzoic acid calculated on changed benzoyl peroxide is 91%.

The chloroform solution is used (with or without drying with calcium chloride) for the preparation of the oxides from olefines. E. B. E.

1154. Standardisation of Kauri Butanol Test for Paint and Lacquer Numbers. L. Beard, L. Shipp and W. E. Spelhouse. *Ind. Eng. Chem., Anal.*, 1933, **5**, 307.—The authors study the effect of deviation of procedure on results obtained, and from their experiments conclude that the choice of gum for the

preparation of the Kauri butanol solution determines to a considerable extent the Kauri butanol values obtained and may produce a variation of as much as 2·5 points. Titrations of solutions of varying gum content with the same petroleum solvent indicate that the Kauri butanol value decreases in a straight line function as the gum concentration increases. They find also the K.b. value is directly proportional to the amount of Kauri solution titrated. For a variation of temperature of 5° C. and 20° C., at which test is made, a discrepancy of 1·3% in the numbers with results. The effect of moisture was studied and results show that the amount of diluent added decreases regularly in a straight line as the water increases up to about 7%. In adopting a standard procedure the authors propose that the Kauri butanol solution become a testing medium only, standardised by a primary standard, the toluene-n heptane blend. The solvent power of a paint and lacquer solvent will be expressed in comparable and reproducible toluene numbers. Toluene has a value of nearly 102 and heptane has a value of 26: thus mixtures of these two will cover the entire range of any ordinary lacquer marketed and used to-day. R. E. D.

1155. Modified Soxhlet. T. R. Liston and W. M. Dehn. *Ind. Eng. Chem., Anal.*, 1933, **5**, 306.—This consists of two Buchner funnels held face to face with a rubber band. The lower Buchner, supplied with closely fitting filter paper suitably weighted, is charged with material to be extracted. Vaporisation and contact of the solvent is carried out in the usual way. R. E. D.

1156. Automatic Water Still. H. B. Gordon. *Ind. Eng. Chem., Anal.*, 1933, **5**, 356.—Consists of a layout using a 500 ml. flask fed with water from the condenser through a constant level trough. A drain from the still is provided to prevent excessive concentration of dissolved material. R. E. D.

1157. Adjustable Temperature Regulator. W. G. Parks. *Ind. Eng. Chem., Anal.*, 1933, **5**, 357.—This consists of the usual mercury reservoir with capillary at the top in which is inserted one electrode. The other electrode is sealed to the body of the reservoir. A side arm is sealed to the reservoir, at the top of which is sealed a metal plunger by means of which variation of the level of mercury in the reservoir can be effected. An accuracy of temperature $\pm 0{\cdot}02°$ C. can be attained with this regulator. R. E. D.

1158. Ground Glass Junctions. H. L. Baumbach. *Ind. Eng. Chem., Anal.*, 1933, **5**, 349.—The writer suggests that by grinding each joint, separately, first with a copper cone, a more evenly ground joint can be finally obtained. The inside of the copper cone is used for the grinding of the taper and the outside for the grinding of the socket. Turpentine and powdered silicon carbide is the mixture used for abrasion. R. E. D.

1159. Micro-bomb for Determination of Organic Halogens. F. E. Beamish. *Ind. Eng. Chem., Anal.*, 1933, **5**, 348.—The determination of halogens in organic compounds by means of a sodium peroxide-sugar fusion in a micro-bomb is described. It was found that pure nickel bomb cups were the most satisfactory from all points of view. Results indicate that halogen content of organic compounds can be determined with the same degree of accuracy and as rapidly by this method as by the macro method. The method is applicable to all compounds which may be determined by the macro method, and has the decided advantage that the destructive explosion can be eliminated. R. E. D.

1160. Variable Control Still Head for Laboratory Columns. S. C. Rothman. *Ind. Eng. Chem., Anal.*, 1933, **5**, 338.—The underlying principle of this apparatus consists in providing for reflux by partial condensation of vapours and for complete and easy control of the reflux ratio. The still head consists of a heavy walled pyrex jacket rounded at the top to afford an ideal deflecting surface for the vapours. The dephlegmator tower inside this is a pyrex tube perforated with small orifices to allow free flow of vapour from the column. For effective partial condensation of the vapour a large area of covering surface is provided for in a spiral condenser. Delicate regulation of the cooling liquid can be obtained by using a needle valve.

The vapour offtake has a glass stopcock in circuit with a calibrated protraction chart; with this arrangement the cock can be operated accurately to any desired degree in the regulation of the vapour flow. A three-way ground glass stopcock is provided in the reflux tube which can be operated to charge reflux either back to the column or to the still as desired. R. E. D.

1161. Multiple Steam Bath. W. L. Beuschlein and W. D. Dehn. *Ind. Eng. Chem., Anal.*, 1933, **5**, 327.—This consists of a steam tight copper bath with inserted funnels available for processes of hot filtering, drying of solids and evaporation of liquids. R. E. D.

1162. Preparation of a Permeable Extraction Thimble. F. T. Williams. *Ind. Eng. Chem., Anal.*, 1933, **5**, 322.—The writer describes a method of preparing a permeable thimble, to be used in a pressure Soxhlet for the hydrogenation of coal. R. E. D.

1163. Diffusion in Paraffin Hydrocarbon Gas Analysis. R. A. Baxter and L. J. Beckham. *J. A.C.S.*, 1933, **55**, 3926–3936.—The authors have made an extension to the Maxwell diffusion equation to apply to a mixture of gases diffusing out through an orifice, which is large in comparison to the mean free path, against air diffusing in at barometric pressure and constant temperature. A simple device is described whereby such diffusion can be carried out and samples of the gas taken before and after the diffusion. This apparatus and the equations developed have been checked against known mixtures of the paraffins, and charts have been constructed which connect Δn, n, and composition. n represents the average number of the carbon atoms per molecule of hydrocarbons in the gas to be analysed, and is deduced from the usual explosion with oxygen, the contraction in volume and the absorption of carbon dioxide formed. Δn represents the change in value of n (an increase) when a similar experiment is carried out on the gas left after the diffusion experiment. This latter is described in detail and takes 195 minutes. Charts are given which, with a knowledge of Δn and n, will give the composition of methane, ethane and propane mixtures or methane, ethane and butane mixtures. It is considered that such a procedure as outlined above will give a much closer approximation to the actual composition of a mixture than will the ordinary explosion method. W. E. J. B.

1164. Measurement of True Gas Temperatures. S. Uchida. *J. Fuel Soc., Japan*, 1933, **12**, 97–98.—A critical description is given of the following methods for the measurement of true gas temperatures, *i.e.*: (1) Shielding thermocouple ends with polished foils of such metals as silver, gold or platinum that have very small black-body coefficients; (2) using thermocouples of very small diameter; (3) extrapolation method using several couples of different diameters; (4) H. Schmidt's method of comparing the input-energy temperature of the same wire and to find the intersection which indicates the true temperature; (5) H. Schmidt's heated junction aspirating thermocouple; (6) high velocity thermocouple. Of these several methods, from the

standpoint of technical manipulation, the high velocity thermocouple is recommended. Experiments are described which show that the most important factor affecting the minimum necessary velocity of gas through the aspirating tube is the ratio, temperature of inner wall of suction pipe : true gas temperature, which must be maintained as near to unity as possible.
G. R. N.

1165. "Nellensteyn Microns" and "Free Carbon" in Road Tars. W. Tietze. *Asphalt u. Teer*, 1933, **33**, 718–719.—A procedure is described for estimating the proportion of macrons and microns, after dilution with nitrobenzene, by successive filtrations through standard filter papers, and determining the "free carbon" in the residue by the benzol method.

Experiment has shown that free carbon found by treating a tar directly with benzol is always smaller than the sum of the microns, macrons and residual carbon, *e.g.*, the benzol method gave 6·5 and 12·2% for two tars compared with 10·2 and 14·8% respectively. The nitro-benzene treatment may be responsible for this.

Owing to the fact that the refractive indices of glass and nitrobenzene are almost equal, micron counts may be difficult, since the markings of a Thoma cell are almost invisible. Use of an ocular micrometer (standardised against the Thoma cell) is recommended.

Varying results, however, suggest either a change in the micron count with time or an unknown source of error.

It is concluded that microns compose only a comparatively small part of the free carbon (not over 1%), and it appears doubtful if a tar can be evaluated on such a minor constituent.
C. C.

1166. Bituminous Emulsions. H. Walther. *Asphalt u. Teer*, 1933, **33**, 698–703.—The method of Weber and Bechler (for breakdown of emulsions) has been adopted, and by carefully controlling the conditions it was found possible to obtain an emulsion which always had the same breakdown value.

A series of experiments has been made to investigate the relationship between breakdown value, free alkali content and pH. For the pH determinations, Drücker's form of hydrogen electrode was used with an alloy of gold and iridium, since platinum was rapidly poisoned. No definite relationship could be established, since with different emulsifiers varying results were obtained.

Various commercial emulsions were examined, at intervals, on standing for periods up to 75 days. In specific cases the pH fell from 10·77 to 9·64 for one emulsion and from 10·39 to 9·12 for another, while the breakdown value rose from 1·6 to 2·9 and 2·5 to 17·2 respectively (in 60 days). In the latter case, sediment formed and water separated, but the first emulsion showed no separation. Tables and diagrams are given for 3 stable and 3 unstable emulsions.

It is concluded that the knowledge of breakdown of emulsions is insufficient to propound a general theory. The question of globule size may play an important part, and this is under investigation.

A further property, the significance of which has not been definitely established, is the adhesion of the bitumen (after separation) to the stone. This is affected, not only by the emulsifier, but also by the origin and method of manufacture of the bitumen itself.
C. C.

1167. Laboratory Drying Agents. *Chem. Trade J.*, 15.9.33, **93**, 198.—The criteria of the ideal desiccating agent are discussed and a list given of a number of laboratory drying agents with their efficiencies based on the corresponding pressure of water vapour in the air over the desiccant. It is shown

that $CaCl_2$ and H_2SO_4 are relatively inefficient, P_2O_5 being the most effective. Magnesium perchlorate is practically as good and has the advantage of freedom from the stickiness and channelling associated with $CaCl_2$ and P_2O_5. In addition it remains porous, does not attack cotton wool, and as it contracts in volume, it is easily removed from U tubes. Its moisture absorption capacity is over 30% of its own weight, and it can be regenerated by heating at 200° C. for 10 hrs. The salt containing 3 molecules of water of crystallisation is more efficient than the anhydrous salt and is more easily prepared. Barium perchlorate and alumina are also efficient drying agents. Silica gel is very useful, but becomes exhausted rapidly. Freshly ignited barium oxide compares very favourably with P_2O_5, and boric acid also has possibilities.

C. L. G.

Class 600. Refining and Refineries.

1168. New Three-Column Pressure Distillate Rerun Unit. G. F. Burdick and P. H. Woods. *Refiner*, 1933, **12**, 344–350.—Up to about three years ago, pressure distillate was rerun using single flash into a bubble tower operating at atmospheric pressure. The pressure distillate was subjected to a temperature of at least 330° F., resulting in heavy treatment costs, due to the injurious effect of the excessive temperature on the charging stock. Steam consumption was high, being of the order of 80 to 100 lb. per barrel of pressure distillate. A reduction of both treatment and distillation costs was effected by the development of the combination atmospheric and vacuum unit, in which maximum temperature was limited to 275° F. The installation of this type of unit has resulted in substantial diminution of treating costs, mechanical maintenance, and stripping steam. Exploration over a two year period using a two stage unit showed that further economies might be secured by a reduction of the maximum operating temperature to 250° F., but that in this type of plant, although treatment costs were diminished by the modified operation, steam consumption for stripping purposes was considerably increased.

Adopting 250° F. as maximum permissible operating temperature, the desirable diminution in the quantity of stripping steam has been achieved in a plant lately completed for the Associated Oil Company at Avon, California, the amount of stripping steam being only one-third to one-half that required in a two stage unit operating at 275° F. The installation possesses three towers, an atmospheric tower, a dry vacuum tower and a final wet vacuum tower, all fitted with fractionating and stripping trays with removable reboilers below the bottom trays.

The charge is heated to 180° F. by heat exchange, and further to 230° F. by the steam preheater, 45% vaporising on entry into the atmospheric tower. The bottoms from the atmospheric tower, 45 to 50% of the feed, pass through preheaters, where the temperature is maintained at 250° F., and where about 60% is vaporised. The partially vaporised bottoms pass into the dry-vacuum column, where all the remaining gasoline, except the heavy ends, are taken overhead. No stripping steam is employed in this tower, but a temperature of 250° F. is maintained by the reboiler.

The small percentage bottoms from the dry-vacuum tower pass to the wet-vacuum tower, where temperature is maintained by the reboiler, and a small quantity of stripping steam is supplied. Reflux to the top tray maintains end point.

Five principal advantages are claimed for this three column unit, *viz.*: lower treating costs due to low temperature operation, economy in stripping steam, requirements for cooling water and the pumping thereof diminished,

because the reflux and steam quantities condensed are small, heating steam in reboilers is reduced, because the amounts of reboil material in conjunction with reflux is small, and a wide flexibility. B. C. A.

1169. Improved Chain-Packed Distilling Column. S. T. Schicktanz. *Bur. Stand. J. Res.*, 1933, **11**, 89-92.—In a previous paper (J. H. Bruun and S. T. Schicktanz, *Bur. Stand. J. Res.*, 1931, **7**, 852) it was shown that a still with a 35-ft. column packed with jack chain had a higher efficiency than any other described. It is, however, expensive to construct and is too high for an ordinary laboratory.

In this paper is described a still and column suitable for a laboratory and similar to that previously noted, with the difference that the column is packed with jewellers' brass locket chain.

A 3-litre still-pot with a column 2·5 cms. diameter and 250 cms. long requires approximately 3600 ft. of chain for filling. Running at 0·5 ml. distillate per minute with reflux ratio 22 : 1, vapour velocity 7·57 m/min. and "hold up" of 180 ml., this still readily separates a mixture of benzene and ethylene chloride, whose boiling points differ by only 3·42° C.

The volume of the charge distilling can be increased as long as the evaporating surface is kept within limits, so that there is no flooding of the column on brisk boiling. One of the controlling factors in obtaining maximum efficiency is the difference in pressure between the still-pot and the still-head. This pressure difference is indicated by means of a differential manometer, which actuates an electrical device and so controls the current in the coil which heats the still-pot. A diagram and full description of the automatically controlled heater unit is included. A table gives results obtained when using different kinds of columns and packings. D. L. S.

1170. Film Coefficients of Heat Transfer. W. C. Edmister. *Petr. Eng.*, Sept., 1933, **4** (13), 25.—The author presents a method for determining film viscosities for heating and cooling conditions. His method has been applied to experimental data of other investigators with good results. L. V. W. C.

1171. Automatic Pressure Regulations for Vacuum Distillation. E. B. Hershberg and E. H. Huntress. *Ind. Eng. Chem., Anal.*, 1933, **5**, 344–6.—The apparatus described includes a thermoconically controlled flutter valve, and in which concentrated sulphuric acid is substituted for mercury as the manostat liquid. This combination permits of a regulation of ± 0.015 mm. mercury at any pressure up to atmospheric. The manostat consists of two bulbs forming a U-tube—these bulbs provide for a sudden change of pressure. Sealed in platinum contacts in the right bulb are made and then actuate the relay which directly controls the leak into the system. By means of a ground steel joint the manostat can be rotated to facilitate making the requisite setting. Sulphuric acid is employed as the manostat fluid, owing to the many objectionable properties of mercury when used in this capacity, such as enormous surface tension, failure to cut glass walls and its filming properties. Evolution of gas from sulphuric acid under vacuum can be reduced to a negligible minimum by boiling 1.71 acid under vacuum gently and cooling away from air. A reservoir is provided in the system to absorb surges. R. E. D.

1172. Thermodynamics and Heat Flow in the Typical Modern Skimming and Cracking Operation. A. Vandenburg. *Oil & Gas J.*, 10.8.33, **32** (12), 13.—The increasing serviceability of heat exchangers for high temperature work has led to new applications of the principle of re-employing stored heat. For steam heating this is performed by transferring the material to be concentrated to consecutive vessels of lower pressure.

The thermodynamics of simple refinery operations are based on the general principle :—Heat produced from fuel=stack losses+other losses+heat to cooling water. The heat flow diagrams of a cracking still and of a two stage distilling plant are reproduced in detail and the method of working out the heat balance explained. The diagram shows the heat conditions with and without heat exchange, 40% more fuel being required in the latter case for a cracking installation. The heat balance is calculated according to the data in Bureau of Standard Misc. Pub. No. 97, "Thermal Properties of Petroleum Products." The correct interpolation of all data requires experience, particularly for very low and high pressures. For determining the boiling point for a certain oil according to the known atmospheric boiling point the Cox chart is the most popular. The approx. boiling point is usually a little above the 50% overpoint of the Engler differential evaporation.

The method for determining the heat balance is as follows :—For atmospheric pressures and up to 45 lb. the heat content of a vapour is taken from Table 17 of Bulletin 97. For higher and lower pressures the boiling point is determined according to the Cox chart and the heat content determined from Tables 15 and 16. For very high pressures, at or above the critical pressure the latent heat of vaporisation is zero and the heat content equals the sensible heat only. At higher temperatures superheat must be added. A Cox chart in which the critical curve is introduced is given.

Detailed heat balance tabulations for a two stage distillation plant, including an atmospheric fractionator, a vacuum pipe still, and a vacuum fractionator are given. Similar data is provided for a cracking still, including the furnace, drum, separator, heat exchanger, fractionator, exchanger, accumulator, condensing and coiling coils. The following points are raised :—(1) The importance of thermodynamical calculations for checking the fuel consumption is emphasised. In the case of the two stage distillation unit 2.25% of the charging stock is used as fuel and 5.5% in the case of the cracking still. (2) Excessive fuel consumption will be accompanied by excessive use of cooling water, oversize facilities for supplying cooling water and unnecessarily large cooling apparatus. (3) The heat flow diagram indicates where heat is wasted and where probable heat may be returned to the process by means of heat exchangers. (4) In the case of the cracking still the diagram indicates clearly the large quantity of heat involved, compared with the small quantity that finally goes into the distillate vapours, owing to the large quantity of circulating stock. (5) It is also suggested that probably a larger amount is dissipated by radiation, due to higher temperatures and large quantities of heat stored in circulating stock than is usually suspected. (6) Hot tar carried off most of the heat supplied, and it seems desirable to apply far-reaching heat exchange at this point. (7) The diagrams show the progressive influence of the practical application of thermodynamics and open up a new field of development, since proper and safe heat exchangers for high temperatures should be produced within the near future. C. L. G.

1173. Low Temperature Carbonisation of Coal in the Presence of Japanese Acid Clay, 3. K. Kobayashi, K. Yamamoto and H. Ishikawa. *J. Soc. Chem. Ind., Japan*, 1933, **36**, 447B.—From a review of previous work by these authors, it is suggested that the following might explain the reactions involved during the low temperature carbonisation of coal in the presence of Japanese acid clay. On heating the fossil resin in coal it melts at about 150° C. and is adsorbed by the clay. At above 200° C. it is partly decomposed into light petroleum hydrocarbons with liberation of carbon dioxide and water, due to the catalytic action of the clay. The reaction becomes more marked at higher temperatures, but ceases at 400° C. With similar treatment at

slightly higher temperatures, the kerogen content also yields light petroleum. The mother-substance of brown coal derived from lignin does not decompose below 400° C., but is converted into phenolic material and free carbon by further heating.

It is possible that the clay prevents the partial overheating of the brown coal, and that the higher content of chemically combined water in the clay serves to lower the temperature of decomposition. W. H. T.

1174. Properties of Clays Used in Contact Treating. L. C. Trescott. *Petr. Eng.*, Aug., 1933, **4** (12), 44.—Fine decolorising clays are divided roughly into two classes, natural clays and acid-treated clays. The former are generally of low decolorising value, but are useful when the neutralisation only of an acid oil is required or high quality steam or demulsibility tests are to be made. For decolorisation by the percolation method coarsely ground clays, which have been dried or burnt, are used. In contact treating where higher temperatures are used excessive drying or burning is unnecessary. Natural clays differ from acid-treated clays in that increased moisture does not usually decrease the decolorising efficiency. Fuller's earth is the most widely used natural clay. Its decolorising value is not usually improved by acid treating, but the coarse clay can be reburned a greater number of times than the acid-treated product. In determining the value of natural clays for contact filtration, the following points should be determined. The p_H value should not be greater than 7. With one exception alkaline clays are worthless for filtration purposes. There should not be a large content of colloidal and very fine matter which would give an impenetrable filter cake. Tests on the oil with a suction filter will indicate filtering values, type of cake amount of oil absorbed, etc.

The best types of acid-treated clays are of Bentonite base (Bentonite is a sedimentary mineral of indefinite composition formed when volcanic ash is deposited under water). They are widely distributed in nature and vary considerably in decolorising value, but few have any value in the untreated state. Acid treatment is simple and consists of roughly pulverising the raw material and treating with half its weight of 66° acid diluted down to 18/25%. Dilute acid separated from acid sludge can be used without ill-effect. After 8 hours heating with open steam the acid salts are drawn off and the clay washed with water, filtered and dried.

With most acid-treated clays it is a mistake to insist on too low a water content, as this decreases the decolorising value. With some clays a water content of 30/32% is perfectly satisfactory. As water subsequently added has not the same effect, the water apparently enters into the composition of the clay. There is some dispute as to the action of the clay, but a catalytic action and a chemical change in the oil appears to take place as well as absorption of the colouring matter on the clay.

A highly effective clay owes its value to the catalysing or polymerising activity which concentrates the colouring matter in the oil so that it is more easily deposited on the clay. Fuller's earth will extract a light black oil, while acid clays appear to retain asphaltic matter, so that the former appears to adsorb only while the latter has a catalytic or polymerising effect.

The German clays are slightly better in quality than the American, but are coarser and more gritty. They are unsuited for use in vacuum filters as the filter cake is brittle and cracks easily, allowing excess air through and causing oxidation and loss of colour in the oil. Reburning the clay gives better results than with American products.

For the neutralisation of acid-treated oils cheap, low powered clays may be used, but these should not be alkaline as oil soluble soaps are formed in the oil. It is frequently more economical to use a high powered clay

owing to the smaller quantity required, higher filter rates and lower oil losses.

The use of high powered clay with a high decolorising value may have an adverse effect on the oxidation and demulsibility values, owing to minute traces of polymerised oil. For such purposes lower power clays should be used and the treating temperatures kept as low as possible.

The importance of testing clays under the conditions under which they will be eventually used is stressed. The decolorisation characteristics of ten representative clays from the U.S. and Europe are graphically shown, the percentage of clay used being plotted against the Lovibond colour of an oil after treatment. C. L. G.

1175. Petroleum and Natural Gas Studies of the U.S. Bur. Mines. *Inf. Circ.* 6737, July.—The circular gives a brief review of the earlier work of the Bureau on oil and gas, showing the types of problems studied and the research procedure that has been followed. The changes in the scope of activities of the petroleum and natural-gas division that have taken place within the last eighteen years are indicated. Specific studies which are being undertaken at the present time are discussed and classified under four main headings. Results obtained to date are summarised. Reference to the principal reports issued on the work already carried out by the Bureau are given. R. A. E.

1176. Long Beach Plant Utilised New Cooling Method. Anon. *Refiner*, 1933, **12**, 351–352.—The plant under discussion produces 20,000 gallons of finished gasoline per day from a raw gas load of about eight million cubic feet of gas. Whilst the practice in the Mid-Continent, etc., has been for the gas leaving the compressors to enter a common header before passage to the cooling coils, in this unit each pair of compressor cylinders is provided with separate cooling units for the discharged gas. Further, the louvre tower basin has been divided into compartments equal in number to the cooling coils serving the compressors, by the provision of concrete dividing walls. Partial shut-down for maintenance and cleaning purposes is thereby facilitated. The operation and performance of the plant, which is of Braun fabrication, is briefly described. B. C. A.

1177. Manufacture of Special Products from Crude Distillation Unit. T. B. Leech. *Petr. Eng.*, Aug., 1933, **4** (12), 20.—In a previous article (see Abs. No. 901, 1933) the relative efficiencies of various methods of refinery fractionation were compared. In the present article the auxiliary fractionating equipment required for the production of special products is discussed. It is assumed that the pipe still single flash method of distillation is being used with a main tower producing 250° e.pt. gasoline, together with side strippers producing naphtha, kerosine and gas oil cuts. It is inadvisable to upset the main distillation unit by attempting to make special cuts on it, while the installation of special shell still and tower equipment is expensive. A flow sheet is given indicating an auxiliary fractionating tower adequate for the producing of special products. In order to produce aviation gasoline or rubber solvent, it is necessary to raise the initial boiling point without losing any heavier constituents. This is effected by mixing proportions of the overhead gasoline plus the top side stream, before or after stripping and feeding through heat exchangers to the refractionation tower. In the upper section of the refractionator the final product is brought to the correct initial boiling point and withdrawn from the bottom of the section. Top reflux with correct instrument control assures a product of proper specifications. Reflux for the bottom section of the refractionator is provided by gravity

flow of the finished product. The refractionator should be designed to operate under pressure sufficient to condense reflux for the particular product and should be piped so that each section can be used as a secondary stripper. Petroleum ether can be made by feeding a portion of the overhead gasoline stream to the refractionator. Turpentine substitute is obtained by feeding the top side steam into the top of a secondary refractionator, using the upper section purely as a stripper. Into the lower section a small quantity of the 400/500° F. distillate should be fed through a heat exchanger and partially vaporised. The flexibility of such an installation for producing a wide range of special products is emphasised. C. L. G.

1178. Adsorption and the Purification and Refining of Petroleum Products. Dubrisay. *Ann. des Comb. Liq.*, 1933, **8**, 607–618.—Experiments were carried out to examine the efficiency of various materials for removing colour, nitrogenous material, sulphur compounds and unsaturated compounds from white spirit. All substances tested, had some decolorising action (animal black and vegetable charcoal were the best); carbon and talc were most efficient in removing amines; carbon, alumina and iron oxide were the best absorbents for sulphur compounds and finely divided silica for olefinic hydrocarbons. Generally speaking, absorbent power increases with fineness of division.

Alumina is particularly valuable for decolorising and desulphurising. To obtain the best results, however, the material must be finely divided and dry; there is an optimum temperature for ignition to obtain the maximum efficiency. C. C.

1179. Heat-Transfer Design Data and Alignment Charts. T. H. Chilton, A. P. Colburn, R. P. Genereaux and H. C. Vernon. *Trans. A.S.M.E. Petr. Mech. Eng.*, 31.5.33, **55** (6), 7–14.—A search was made, during a research programme on heat transfer, for the best available methods for the prediction of heat-transfer coefficients and for means of simplifying design calculations. The equations selected or developed on film coefficients are given in the paper for gases flowing in turbulent motion inside tubes, for gases flowing across tube banks, for free convection outside horizontal cylinders and at vertical surfaces, and for condensing vapours. Alignment charts are given for the solution of these equations. A simplified method of designing gas-heat exchangers was worked out on the basis of one of the equations for the heat-transfer coefficient, and a chart is also given for pressure-drop calculations made in designing heat-transfer equipment. W. W.

1180. Modern Pipestill Heater Design: III. Recirculation Stills. W. L. Nelson. *Petr. Eng.*, June, 1933, **4** (10), 23.—The advantages claimed for the recirculation type of pipestill heater are briefly discussed and a comparison presented between the characteristics of typical simple radiant type stills and of recirculation stills.

The important advantages of a recirculation still are

(1) Control of rate of radiant absorption by adjusting the quantity of flue gas circulated.

(2) A low rate of radiant absorption can be obtained without building an excessively large radiant section.

Increasing the heat duty of an ordinary still increases the rate of radiant heat absorption greatly, which may cause overheating, whereas in the recirculation type this can be overcome by increasing the recirculation of the flue gas. Similarly, reducing the absorption rate in ordinary stills causes a large loss of efficiency.

The thermal characteristics of typical examples of simple and recirculation type stills are given and the total length of tubing required in the radiant and convection banks worked out.

It is shown that in general recirculation stills require less surface for the same efficiency than simple stills, but this is balanced by the extra cost of recirculation equipment and of the necessary gas tight construction of the recirculation still. The initial and operating costs of the latter are thus greater and the economy of the installation depends on the advantages resulting from control of the rate of radiant absorption.

A table is given showing the comparative efficiency of six examples of the two types of stills and a chart reproduced, plotting the absorption rate against the fraction absorbed in the radiant section.

It is pointed out that air preheat increases the flame temperature and the rate of radiant absorption so that it tends to defeat the advantage of flue gas recirculation. The higher efficiency given by air preheat can be obtained by building a larger convection section at about the same cost, while at the same time closer control over the flame can be obtained if the primary air is under slight pressure as in the preheat system. C. L. G.

1181. Air Cooled Furnace Walls. G. P. Reintjes. *Petr. Eng.*, July, 1933, **4** (11), 25.—The circulating air in the air lanes of furnace walls does not actually cool the refractories, but absorbs heat from the furnace through (*a*) radiation through joints between the tiles; (*b*) absorption and dissipation of heat through the tile supporting metal; (*c*) transfer of heat through the refractories. The last factor is of the least effect. In most walls the refractories are cooled by operating the furnace so that there is a lower pressure within the furnace than in the surrounding cooling air, leaking taking place from the air lanes into the furnace at the expense of furnace efficiency, particularly if leakage takes place above the tube line.

In open hearth furnaces spaces are purposely left between the bricks for cooling purposes, this also having the effect of reducing the amount of preheat available for the circulating air.

Owing to the much more rapid rate of absorption of heat by metal surfaces than by refractories metal should be kept as far as possible out of the joints between the refractories, as otherwise it will tend to heat them.

When the preheated air taken from the furnace is not used for cooling the refractories, air lanes and casings must be designed to reduce radiation to the atmosphere. In insulating the air lanes to save the preheated air it is essential that the metal supporting the walls does not project through the casing, as in most furnace walls where this is the case, more than half of the preheated air is lost to the atmosphere by radiation through the casing. Lumber asbestos is recommended for this purpose.

In designing a supported wall, the total thickness of the refractories should be as uniform as possible to reduce varying temperature gradients and internal strains on the tiles.

On oil stills it is seldom necessary or advisable to air cool the refractory wall. While the supported wall reduces the maintenance on stills to practically nothing, leakage of air from the still through the many common types of walls causes secondary combustion, eventually resulting in burned out tubes. C. L. G.

1182. Patents on Cracking. C. J. Greenstreet. E.P. 397,468, 18.8.33.—A distillate substantially free from tar acids is obtained from mixtures of creosote oils, tar acids, etc., and mineral oil (at least 50% and of the same boiling range). The mixture is atomised or vaporised with or without the aid of steam or residual gases and then heated to 350°–650° C. in contact with a

catalyst in a conversion zone. The product is withdrawn immediately conversion has taken place and before any appreciable destructive action has occurred due to excessively prolonged contact with the catalyst.

W. G. Laird. U.S.P. 1,926,009, 5.9.33. Residual oil from the expansion zone of a cracking plant is distilled without further cracking, the resultant vapours condensed and the uncondensed gas passed through the distillation residue. The latter is recycled through the cracking plant.

T. Seifer. U.S.P. 1,926,563, 12.9.33. Cracking by the use of a metal bath, with means for obtaining a constant and uniform temperature. The vessel containing the molten metal is subdivided into a heating and a reaction space. The oil to be cracked is introduced by means of a jet into one end of the metal bath and cracked material withdrawn from the other end. The molten metal is withdrawn at the point of separation of oil and metal, and returned by the kinetic energy of the fresh hydrocarbon to the place where the latter enters the bath.

W. H. Bahlke. U.S.P. 1,927,059, 19.9.33. Means for the removal of coke from reaction chambers. Holes are drilled into the coke and filled with an explosive which, when fired, blasts the coke free from the chamber.

F. W. Sullivan. U.S.P. 1,927,074, 19.9.33. A combined process of cracking and destructive hydrogenation. The apparatus consists of a pipe heater (800° F.), an electric heater for heating hydrogen containing gases to 1200° to 1500° F., and a soaking drum in which the preheated gas and oil are mixed and maintained at a pressure of 150–300 lbs. per sq. in.

C. P. Dubbs. U.S.P. 1,927,156, 19.9.33. Cracked vapours are passed through zones of successive dephlegmation, the charge stock being used as dephlegmation medium in a secondary zone, and condensate in the primary zone. The vapours passing over from the last dephlegmator are condensed.

G. Egloff. U.S.P. 1,927,159, 19.9.33. Cracked vapours are passed to a dephlegmator in which reflux condensate is allowed to collect. The major portion of the condensate is returned to the cracking stream, the remainder being withdrawn, heated and then returned in heat exchange relationship to the main body of reflux condensate.

J. D. Seguy. U.S.P. 1,927,187, 19.9.33. Unvaporised oil is removed from a reaction zone and flash distilled by pressure reduction. A portion of the resultant vapours are dephlegmated and the reflux condensate recycled. Another portion is subjected to vapour phase cracking, the vapours obtained being introduced into the unvaporised oil in the flashing zone, to augment the vaporisation thereof.

R. E. Goldsbrough. U.S.P. 1,927,452, 19.9.33. Tars and tar oils are injected together with steam at above 2 atm. pressure into a series of reaction zones having surfaces of nickel-chromium alloy containing small proportions of silicon, zinc and iron. The oil is vaporised in the first zone (700–1000° C.), and the vapours passed through succeeding zones of alternately restricted and enlarged cross section, thereby promoting turbulence and pressure changes.

A. E. Harnsberger and C. L. Smith. U.S.P. 1,927,829, 26.9.33. Vapour phase cracking in which "dry" oil vapour is heated to above 1000° F. in order to effect decomposition. The products of conversion are then quickly cooled by admixture with cool hydrocarbon oil to a temperature below that of conversion.

A. E. Harnsberger and C. B. Watson. U.S.P. 1,928,102, 26.9.33. Oil is heated to 600° C., the vapours separated and passed through a secondary

stage of separation for the removal of entrained liquid. The "dry" vapours are finally cracked at above 1000° F.

R. R. Irwin and E. C. Marshall. U.S.P. 1,928,494, 26.9.33. Oil vapours are passed into a refractory cylinder surrounded by a granular refractory packing. A heat source maintains a controlled combustion in the packing and a mixing chamber is provided for cracked vapours and products of combustion of the heat source. Means are provided for ensuring that no mixing takes place in advance of the mixing chamber, and a passage is provided for leading the vapours to a fractionating tower and a condenser.

W. H. T.

1183. Patents on Coal. Cunard Steam Ship Co. E.P. 396,432, 2.8.33.—A liquid fuel is described which consists of cracked fuel oil, having a fixed carbon content of not less than 5%, mixed with coal so pulverised that all passes a 180 mesh sieve and practically all passes 200 mesh. It is claimed that the coal will remain in stable suspension without any additional stabilising means.

T. R. Dixon. E.P. 398,601, 21.9.33. Production of ethers, spirits, oils, etc., by treatment of coal with a bacterial organic acid and/or with fungi or enzymes developed at a later stage. The treated material is distilled in order to obtain the desired products.

R. Wietzel. U.S.P. 1,925,551, 5.9.33. Recovery of hydrocarbon oils from mixtures thereof with solid carbonaceous material by heating the materials in the form of an alkaline emulsion. W. H. T.

1184. Patents on Gas. A. C. Hartley and Anglo-Persian Oil Co. E.P. 397,540, 28.8.33.—Gases are separated from liquids (*e.g.*, natural gas from crude oil) by subjecting the mixture to turbulent flow before its division into a number of narrow non-turbulent streams. This procedure causes the disengagement and coalescence of minute gas bubbles, the latter rising at an angle to and in the same direction as the flow and accumulating above the liquid. The gaseous and liquid products are discharged in such a manner as to avoid remixing the gas with the liquid.

I. G. Farbenind. A.-G. E.P. 397,987, 7.7.33. Manufacture of acetylene from gases of the methane series. The gas is treated in a plurality of electric arcs, the energy of which increases at each stage, in such a manner that the concentration of acetylene formed is also increased at each stage. The acetylene is removed from the gases after each stage. W. H. T.

1185. Patents on Motor Spirit. Du Pont de Nemours. E.P. 398,219, 7.9.33.—Gum or colour formation in motor fuels is prevented by the addition of a small proportion of an amine salt of a phenolic compound in the absence of dyestuffs.

H. H. Cannon. U.S.P. 1,926,226, 12.9.33. A method of sweetening petroleum containing mercaptans and free sulphur. A stream of the fuel is passed through a mass of powdered solid reagent comprising litharge, a hydroxide of an alkaline earth metal, a hydroxide of an alkali metal and a porous earth.

F. B. Behrens. U.S.P. 1,927,147, 19.9.33. A method for refining oils containing mercaptans in which the latter are converted into lead mercaptides by treatment with plumbite solution. The oil is then treated with a permanganate to convert the mercaptides into lead oxide.

J. C. Morrell. U.S.P. 1,927,182, 19.9.33. Refining hydrocarbon distillates by vapour-phase countercurrent treatment with an aqueous perborate solution. W. H. T.

1186. Patents on Lubricating Oil. Gulf Refining Co. E.P. 398,032, 7.7.33. —Treatment of petroleum with aluminium chloride at temperatures not exceeding 150° C. in the presence of an excess of a chlorine containing gas which is introduced into the oil prior to or during treatment. Aluminium chloride sludge is removed and the resultant synthetic products recovered.

W. Helmore and E. W. J. Mardles. E.P. 398,222, 11.9.33. In order to prevent deterioration of lubricating oils, the latter are blended with small proportions (less than 1% by weight) of metallic tin or an organic compound of tin (*e.g.*, tin oleate, tin naphthyl, tin ricinoleate, tin phenyl and tin methyl iodide). In addition to the tin compound, tetra-ethyl lead or lead oleate may also be added. The lubricating oil concerned may be a vegetable oil, castor oil or a blended vegetable and mineral oil.

W. L. South and C. T. Anné. U.S.P. 1,925,824, 5.9.33. A method for filtering adsorptive material from lubricating oil. The adsorptive material is removed by filtration and adhering lubricating oil washed from the cake of adsorptive by means of petroleum naphtha. The cake is washed with gas oil to remove traces of solvent, and the gas oil is removed by the passage of an inert gas through the cake.

C. M. Ambler. U.S.P. 1,926,188, 12.9.33. Purification of used lubricating oil by heating in a pipe still to above 100° C. and subjecting the hot oil to centrifugal treatment.

J. A. Anderson. U.S.P. 1,927,057, 19.9.33. Separation of dissolved wax from oil of narrow boiling range. A wax of different distillation range than that of the dissolved wax is added to replace a part of the latter. By this means part of the dissolved wax is thrown out of solution and may be separated, the added wax being removed by distillation.

L. L. Davis and G. L. Atkinson. U.S.P. 1,927,823, 26.9.33. Production of light coloured lubricating oils from those containing unsaturated hydrocarbons. Moisture is removed from the raw oil, which is then oxidised, treated with sulphuric acid and finally neutralised.

C. W. Stratford. U.S.P. 1,927,853, 26.9.33. Lubricating oils are refined by heating, dehydration under reduced pressure, followed by multi-stage acid treatment, with intermediate stages of centrifuging and a final neutralising treatment. W. H. T.

1187. Patents on Asphalts and Fluxes. Highways Construction, Ltd. E.P. 396,545, 10.8.33.—Coloured asphaltic surfacing compositions are produced by heating finely-ground natural asphalt rock to a moderate temperature sufficient to drive off the moisture without causing the mass to fuse. A pigment in the form of a powdered mineral oxide of the desired colour is then incorporated mechanically with the dried asphalt so that a homogeneous, granular mass is obtained. Proportions are chosen to give a soluble bitumen content of 8–12% of the mass. S. B.

I. J. Novak. U.S.P. 1,925,085, 5.9.33. In order to overcome the difficulty of dissolving gilsonite in ordinary solvents (*e.g.*, benzole), it is proposed to reduce its colloidal characteristics and increase its solubility by subjecting the material to a temperature slightly above its boiling point. W. H. T.

1188. Patents on Kerosine.—S. H. Sherwood. E.P. 397,302, 24.8.33.—A modified burner of the flat wick type in which accumulation of pieces of charred wick is prevented by a fixed conical fitment which deflects any detached pieces of char away from the flame. S. B.

E. Holland. E.P. 398,648, 21.9.33. Means are provided for preventing the wick or flame of oil-burning lamps from climbing beyond a predetermined height whilst burning, thus obviating the risk of the lamp smoking or firing. Bars are attached to the cone of the burner above the wick holder and arranged at right angles to the length of the wick tube in flat wick burners, and diametrically in circular wick burners. W. H. T.

1189. Patents on Special Products.—C. F. Fitts. E.P. 397,317, 24.8.33.—Grease and dirt are removed from metallic surfaces by projecting a stream of hot oil-water mixture under pressure on to the surface to be cleaned. An extension of the hot water line passes through the oil storage tanks, heating the oil to a temperature of 130°–160° F. A regulated amount of the heated oil is injected into the water stream, and under these conditions a permanent colloidal suspension of the oil in water is obtained. S. B.

Standard Oil Dev. Co. E.P. 397,699, 31.8.33. Preparation of resins from cracked residues by interaction of the latter with aluminium chloride at 212°–356° F. Sludge is separated and the treated tar distilled under a vacuum (300°–660° F. at 1 mm. press.) to give a resinous residue which is freed from asphaltenes by means of a selective solvent for resins. The resin solution is finally decolorised and the solvent evaporated.

G. T. Morgan and A. E. J. Pettet. E.P. 397,847, 29.8.33. Production of refined phenol by treatment of the impure material with formaldehyde and with an acid or alkaline catalyst at elevated temperatures, followed by redistillation.

Howards & Sons, Ltd. E.P. 397,883, 1.9.33. Manufacture of cyclohexylcyclohexanol by catalytic hydrogenation of cyclohexylidene-cyclohexanone at 150° C. and 10 atm. press.

Standard Oil Dev. Co. E.P. 398,218, 7.9.33. Production of alkylated phenols by contacting a mixture of phenol and an aliphatic hydrocarbon or a cyclic olefine having more than two carbon atoms, with conc. sulphuric acid at normal or slightly elevated temperatures (70° C.). The reaction mixture is steam distilled to give the alkylated phenol.

K. Noack. E.P. 398,474, 6.9.33. Production of highly-polymerised aliphatic alcohols free from low-polymerised products. Alcohols containing at least three hydroxyl groups are heated (250°–275° C.) in the presence of condensation means consisting of heavy metal salts, until the reaction mixture is highly viscous. Water of condensation is removed as formed by passing an inert gas through the reaction mixture. The final product is used for the manufacture of explosion-proof lubricants containing talcum, etc.

R. A. Morgen. U.S.P. 1,926,813, 12.9.33. Clarification of used dry-cleaning fluid by treatment with an activated siliceous material.

R. S. McClaughry and L. V. Moore. U.S.P. 1,927,068, 19.9.33. Sweetening of white spirit by treatment with doctor solution in the absence of free sulphur. The spirit is given a number of water washes and a final treatment with alkaline hypochlorite solution. W. H. T.

1190. Patents on Refinery Plant.—H. W. Sheldon. U.S.P. 1,926,116, 12.9.33.—A fractionating column fitted with inclined baffles so arranged as to discharge reflux from one to another. Steam pipes are placed on the upper surfaces

of the baffles, forming parallel wiers over which the liquid flows in descending the baffles.

E. J. McKee and R. R. Rakestraw. U.S.P. 1,927,042, 19.9.33. A scrubber for the removal of carbonaceous substances from oil vapours is described. Counter-current contact with wash oil is employed and a portion of the separated oil is recirculated through the scrubber in admixture with the fresh oil.

W. W. Gary. U.S.P. 1,927,636, 19.9.33. Apparatus for proportionally mixing oil with a liquid reagent by the use of automatically-controlled nozzles situated in Venturi tubes through which the oil flows.

W. M. Stratford. U.S.P. 1,927,652, 19.9.33. A fractionating column fitted with reboiler and means for supplying reflux to the top of the column. The oil to be fractionated is introduced at an intermediate point and an intermediate fraction is withdrawn from below the point of entry of the oil.

A. Kremser. U.S.P. 1,928,225, 26.9.33. Fractionating equipment with special means for controlling the distillation by the addition of reflux to the top of the column. W. H. T.

Class 700. Utilisation.

1191. Semi-Luminous Flame Obtained with Heavy Domestic Fuel Oils in a Specially Designed Furnace. P. L. Mikeska, *Trans. A.S.M.E. Petr. Mech. Engineering*, 31.5.33, **55** (6), 15–25.—Some advantages of the semi-luminous flame for oil-burning furnaces are taken up in the early part of the paper. To assist in understanding some of the mechanics involved in obtaining the semi-luminous flame a diagrammatic sketch, read in conjunction with sectional illustrations of a specially designed heating furnace fired with heavy domestic fuel oil, labels the happenings inside the furnace. This diagrammatic sketch shows four main branches, A, B, C and D, coming off from the flame, and each of these branches has in it several blocks labelled with some of the factors involved. The article deals with the factors which are: Branch A—oil atomization, primary air and initial chemical reactions; Branch B—secondary combustion air for intermediate and final chemical reactions; Branch C—the thermal setting for proper flame temperature; Branch D—specially designed steel boiler made necessary to co-ordinate properly the many factors involved (such as proper size and correct proportion of the combustion chamber) to obtain the clean, quiet and efficient semi-luminous flame. W. W.

1192. Electric Propulsion for Cargo Ships. R. Reid. *Shipbuilding and Shipping Record*, 1933, **42**, 317–18.—Three systems of cargo ship propulsion in common use are, steam-engine drive, Diesel-engine drive and electrical drive. The author considers that Diesel-electric drive has many advantages over steam or direct Diesel drive, and, on the assumption that a slow-turning propeller gives the most satisfactory results, gives comparative figures for the three drives on the basis of propeller revolutions for a shelter deck cargo ship 355 ft. by 49 ft. by 26·5 ft. These figures show that the Diesel-electric drive will allow of an increase in cargo capacity of 8% and 16% over the direct Diesel and steam-engine drives respectively. G. R. N.

1193. Alcohol-Petrol Fuel. H. Arnstein. *Petr. World*, 1933, **30**, 248–252.—The use of alcohol-petrol fuels is defended by the author by copious quotations from published literature. These show that (1) Alcohol fuels are used in a

number of countries. (2) Alcohol fuels give increased engine performance; the engine starts readily; oil consumption is normal; there is no corrosion. (3) Alcohol fuels have proved highly satisfactory for motor-car racing, as well as for tractor work. (4) Alcohol fuels have been successfully used in organized motor transport. (5) The absorption of moisture by alcohol fuels with subsequent separation of the gasoline is unduly stressed as a serious disadvantage and is not borne out by experience. (6) The use of alcohol is primarily intended to improve the qualities of gasoline and not to rival this fuel. G. R. N.

1194. Potential Market for Road Oils. F. R. Staley. *Petr. Eng.*, July, 1933, 4 (11), 73.—Investigations conducted by the U.S. Bureau of Public Roads have showed that excellent all-weather surfaced roads can be constructed at a very low cost by using liquid asphalts of good quality.

The specifications recommended to the Federal Specifications Board for the slow, medium and rapid curing types are reproduced and the purposes for which the various grades used are discussed.

Brief reference is made to the use of asphalt emulsion and to their classification into the three types—stable, unstable and intermediate—given by Fain and Hixson (*Chem. & Met. Eng.*, April, 1933). C. L. G.

1195. Paraffin Wax Paper Size. Anon. *Oil, Paint and Drug. Rep.*, 1933, **124** (14), 49.—A new type of paraffin wax size for paper, which is prepared by the use of an emulsifying agent without employing high-speed mechanical agitation was described in a paper presented at a recent meeting of the Techn. Assocn. of the Pulp and Paper Industry at Appleton, Wisconsin. It was pointed out that emulsions of paraffin wax in water used for sizing paper are ordinarily made up by machines which break up the wax into minute droplets and disperse them through the solution. Paper manufacturers who prepare their own emulsions must make a rather high investment in such machinery, which requires considerable power for its operation; or, if they purchase emulsions already prepared, they must pay freight charges on large amounts of water. These expenses can be eliminated by preparing paraffin wax emulsions with the aid of a newly-developed emulsifying base. The base, which is virtually water-free can be supplied either separately or as an emulsion containing 80% of paraffin wax. In either case paper manufacturers can make up aqueous emulsions of any desired paraffin wax content without the use of special power-operated equipment.

G. R. N.

1196. Renovation of Insulating Oils. A. E. Williams. *Chem. Trade J.*, 8.9.33, **93**, 174.—The removal of impurities from used insulating oils is at present accomplished by centrifuging or by filtering. These processes cannot be considered entirely satisfactory, principally because neither removes acids derived from the oils, which are the chief causes of the breakdown of the oil. Recently it has been found that total acidity, moisture and sludge can be removed from the oil by the use of a special type of activated carbon. One company now markets a special carbon for the purpose. This carbon has an alkaline reaction imparted either by natural alkaline ash present in the carbon or by adding lime to the carbon. The type of carbon most suitable is one having a p_H value of 7·2–8·5 (based on the ash content of the carbon), and the amount required depends on the hydrogen-ion concentration of a water extract from the oil. When the minimum economical amount of carbon is used for absorption of water, sludge, etc., the p_H content of the carbon must be that quantity which will raise the p_H value of the water extract to 7·07.

The oil is pumped to a mixing vessel, the requisite quantity of carbon added and the mixture stirred vigorously for an hour or so. A small quantity of kieselguhr is then added. The whole mass is pumped through a filter press, in which the plates are first covered with a cotton press-cloth, and finally with dry filter paper. As the particles of kieselguhr are larger than those of the carbon black, they form a protective film on the filter-cloth and paper, so that all carbon may be effectively arrested and recovered from the oil. The temperature of treatment must be kept as low as possible, or the carbon black loses its capacity for absorption of water from the oil. The amount of carbon required to treat average used transformer oil is less than 1% of the oil. R. A. E.

1197. Patents on Engines.—E. Bagnall-Bull. E.P. 397,849, 29.8.33. A decarbonising device to be fitted to the induction systems of I.C. engines. It consists of a water container, through which a current of air is passed, the air being then directed through a second chamber containing a decarbonising substance. W. H. T.

ABSTRACTS.

Class 100. Geographic Occurrence.

1198. U.S. Code for the Petroleum Industry. J. E. Pogue. *Refiner*, 1933, **12**, 406–407.—The petroleum code signed by the U.S. President lays down a new set of rules for the conduct of the oil business, consisting essentially of three groups of provisions and objectives.

1. Regulations governing hours of labour and rates of pay.
2. Production control intended to bring about and maintain a balance between crude oil supply and consumer demand for petroleum products.
3. Marketing rules largely concerned with the standardisation of marketing practices in the distribution of petroleum products.

Fundamentally, the new deal for the petroleum industry centres around the mechanism for the attainment of economic equilibrium, which conception is by no means new, as instanced by the inception of pro-ration in the Seminole district in Oklahoma, seven years ago. This system of control failed to bring either stability or prosperity to the industry because oil field development was not retarded, economic rivalry between States was left relatively untouched, and no effective technique was developed for balancing supply with consumer demand.

The present code aims to avoid these defects by providing for the development of new fields according to plans approved by the President, by co-ordinating the output of the several States so as to prevent unfair invasion of trade channels by any single State, and by specifying a balance between supply and consumer demand. Certain price fixing provisions are included in the code but production control is considered by the author as offering surer stability than a government guarantee of price. Although the present system of control is considered superior to that previously operating, much depends upon the manner in which it is handled and developed. B. C. A.

1199. World Production of Petroleum, 1932. J. Filhol. *Ann. des Comb. Liq.*, 1933, **8**, 915–956.—This comprehensive article gives the world petroleum production of all the principal producing countries for 1931 and 1932. The American production is dealt with in detail, *e.g.*, State production in barrels for 1930, 1931 and 1932 is given. American imports and exports of various grades are given for several years and statistics re refineries, straight-run spirit, cracked spirit, and natural gasoline production are tabulated. Information of a similar character is given for the following countries: Russia, Venezuela, Rumania, Persia, Mexico, Dutch East Indies, Colombia, Argentine, Peru, Trinidad, India and Poland.

The compiler concludes that 1932, although far from satisfactory, was not so bad a year as 1931, from the economic and financial points of view. Certain figures are also expressed graphically. W. E. J. B.

1200. Structure and Accumulation in Ector County, Texas. A. Young. *Oil Weekly*, 9.10.33, **71** (4), 18.—The western part of the county lies over a large, elevated, mesa-like structure running north and south. To the east there is a deep basin, at the foot of a relatively steep slope from the high. The east edge of the Central Basin platform is puckered into a series of low, elongated domes from which comes the oil production. Much variation in thickness of the Permian sediments leads to a difficulty in "marker" horizons, but a potash salt bed marker is found consistently. This variation in thickness is thought to be due to the unevenness of the floor of the Permian

sea. The deep basin is probably where organic sediments have collected, and the oil subsequently formed moved up-dip to the traps, where it is now found.

Penn Pool is the oldest pool, a broad assymetrical anticline, with production from Permian dolomite, on the steep eastern flank. North Ector Pool produces from sandy dolomite. P. A. S.

1201. Production of La Société Pechelbronn, 1932. Anon. *Ann. des Comb. Liq.*, 1933, **8**, 911.—A brief statement which indicates the crude produced and the finished products obtained therefrom for the year 1932. The main products were kerosine (13,671 tonnes) and lubricating oils (29,000 tonnes). W. E. J. B.

1202. Production of La Société Lyonnais, 192. Anon. *Ann. des Comb. Liq.*, 1933, **8**, 912.—Similar information as given in Abstr. No. 1201. W. E. J. B.

1203. Oilfields of Poland, Geological and Statistical Summary. C. Bohdanowicz. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 1084–1097.—This article is, in the main, a tabulated summary of the oilfields of Poland. It includes data on the area of each individual pool, number of producing wells, new drilling wells, initial production, and present production. A short statement of the geological structures and the sequence of the rocks is given. The gravity and quality of the crude oil is also noted, and an estimate is made of the available oil reserves.

It is stated that the area of total producing oilfields in the Carpathian province is 7,300 hectares, and the reserves available on this proven territory do not exceed 500,000 cars. V. C. I.

1204. Planned Development of Oil Fields as Units Discussed in Russia. L. C. Uren. *Nat. Petr. News*, 11.10.33, **25** (41), 23–24.—The papers read at the first congress of the All-Union (Russia) Petroleum Scientific Engineering are reviewed and reports given on the views of Russian scientists on the best method of operating Soviet oilfields on a unit basis. The All-Union Petroleum Scientific Engineering Society has been formed for the purpose of promoting the application of petroleum technology to the Russian oil industry. W. W.

1205. Petroleum Markets in Norway. J. T. Sviland. *Mon. Petr. Roum.*, 1933, **33**, 1175–1179.—The author gives a short account of the geography of Norway, its economic life and its monetary system. Statistics are given which relate to the above, and in particular to the fishing industry. From this short survey it becomes apparent that the major factors in determining the utilisation of petroleum products in this country are the development of the motor fishing fleet and the development of road transport by automobiles. Tables are given which trace the growth of both of these influences during recent years. Since the mountainous character of the country renders railways difficult and costly to construct, it is natural that the development of roads and motor transport should have been considerable. The author then considers the importation of petroleum into Norway and gives statistics showing the grades of products imported, the values of these products and their origins. It is interesting to note that in 1932, 53·1% of the total imports of petroleum products were furnished by England. The paper is concluded with a list of the principal importing companies of Norway and the sale prices of most grades. It is seen that motor spirit, kerosine, gas oil and

crude are free of import duty. Other oils, not destined for use in lighting, combustion or production of energy, are taxed 0·036 couronne per kg. (19·90 couronne are equivalent to £1 approximately). From July 1st, 1933, to June 30th, 1934, motor spirit will be taxed 0·10 couronne per litre.

A certain amount of alcohol mixture is used in Norway, but on a reduced scale. W. E. J. B.

Class 200. Geology and Origin.

1206. **Mechanics of Formation of Salt Domes with Special Reference to Gulf Coast Salt Domes of Texas and Louisiana.** D. C. Barton. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 1025–1083.—The salt of the salt domes of the Gulf States and Germany is primarily of sedimentary origin, and appears to be the result of local growth of a salt core by flowage of salt under pressure. This pressure is due either to the weight of the sedimentary overburden or to tangential thrusting.

Considering firstly the conditions produced by the weight of overburden the initial differential pressure may be due to irregularities in the roof of the salt or to warping or faulting of the sedimentary cover. If this differential pressure, due to the difference between the weight of sediments on the mother salt layer and the weight of salt and sedimentary cover at the embryo dome, is sufficient to overcome friction and uplift the salt against gravity, then growth of the dome will be largely by upthrust. If the available energy is sufficient only to overcome friction, the salt dome will still grow but only by downbuilding in the subsiding area. If the differential pressure is insufficient to overcome friction, growth will cease.

Growth by upthrust and downbuilding may occur simultaneously, their relative importance is often determined by the size of the salt dome.

Lateral pressure may produce salt dome growth firstly by the production of differential vertical pressure on the salt layer between the anticlinal and synclinal portions, and secondly by direct horizontal thrusting on the upper part of the salt cores. These effects are always borne in association with static weight effects and may be completely masked by them.

In the Gulf States the salt domes have resulted from static pressure alone, there being no evidence of tangential pressure. The method of growth has been mainly by downbuilding associated with the gradual depression of the sedimentary basin as the Tertiary and Quaternary sediments accumulated. Only in the case of some of the larger domes is it considered that the differential pressure would have been sufficient to produce actual upthrust of the salt mass.

Growth of the domes has been discontinuous. It has ceased in most cases, the time of cessation varying widely from Eocene to Pleistocene. In some cases growth appears to be still active. Broadly it may be claimed that the deeper domes ceased to grow at an earlier period whereas the shallow domes have generally continued movement into recent times. In some rare cases there are some indications of retrograde movement of the upper part of the salt core.

Cessation of growth may be due to exhaustion of the mother salt layer, to attainment of static equilibrium, to high frictional resistance to change of form, or to cessation of regional subsidence. V. C. I.

1207. **Studies in Paleogeology.** A. I. Levorsen. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 1107–1132.—The author has reconstructed the probable geological outcrop maps for the United States at three periods of its geological history. These are at the base of the Mississippian, Pennsylvanian, and

Comanchian. The maps are compiled from outcrop evidence and boring strata, and they give a general clue to the earth movements previous to each chosen time interval and also to the movements between them.

It is claimed that there is considerable scope for the application of these maps and the deductions obtained from them, to the search for new oilpools and the proper understanding of the facts governing the occurrence of many of the known pools. Such features as sand wedges against old shore lines covered by an impervious cap rock are examples of these phenomena, and necessitate a careful study of the sequence of events in the areas of study. A set of examples are taken from the American oilfields, and each is examined from this point of view. The examples include the Seminole District, Midway-Sunset District, and North-east Texas. V. C. I.

1208. Pseudo-Tectonic Structures. W. G. Woolnough. *Bull. Amer. Assoc. Petr. Geol.*, 1933, **17**, 1098–1106.—The curious behaviour of the Bulli Shale underlying the Bulli Coal seam of New South Wales does not appear to be the result of tectonic stresses. It is found that the rolls and faults in these beds are confined to an area where the Bulli Seam is brought close to the surface by denudation. This has led to the suggestion that these local structural features are due, not to a general compression of the region, but to internal stresses set up by hydration and other changes in the shale body due to access of meteoric water. The author cites a similar case of internal expansion in the Wianamatta Shales near Sydney, where the results appear to be due to weathering and deposition of limonite on a considerable scale. In central Queensland concretionary activity has occurred in some places on a gigantic scale and has so completely disturbed the local outcrops that it has greatly confused the apparent structure. In Papua many of the local complexities in the structure which have been described may be due to the shattering of fold crests by the swelling of bentonitic clays to which water has obtained access. V. C. I.

1209. Note on Mud Flow. C. C. Wilson. *J. Inst. Petr. Techn.*, 1933, **19**, 878–884.—A short paper with discussion given at the Trinidad branch on the subject of Green Clay Mud Flow in the Palo Seco and Canari districts. G. R. N.

Class 300. Development and Production.

1210. Heavier Drilling Equipment at Kettleman Hills. B. Mills. *Oil Weekly*, 23.10.33, **71** (6), 32.—The general trend in the Kettleman Hills area is towards heavier drilling equipment. Light, fast equipment has been considered but there is little likelihood of its adoption.

Refinements in equipment still continue to make their appearance, but in the majority of cases increase in strength has been the major consideration.

A number of the refinements are dealt with in this article.

L. V. W. C.

1211. Salvaged Pipe, Drilling Lines make "A" Frames for Pulling Wells. Anon. *Oil Weekly*, 16.10.33, **71** (5), 26.—As a means of pulling casing, frames made from 8-in. casing have been very successful. Six joints are used for each frame, three joints being screwed together with short collars and cut to a standard length of 60 feet. The legs are spaced 6 feet apart at the bottom and taper towards the top until just sufficient room remains for a single sheave and block. Nine spacers are used to provide the necessary rigidity. At the top immediately under the sheave block a spacer casting

is bolted to the two legs. At the bottom another spacer casting is placed and bolted so that the legs cannot pull apart. Four guy ropes, made from old drilling and sand lines, are secured at the top of the mast and the lower ends are fastened to anchor posts. L. V. W. C.

1212. Power Requirements for Pumping Wells. O. Duda. *Oil Weekly*, 16.10.33, **71** (5), 14.—The author analyses a pumping cycle of a reciprocating, single-acting type well pump operated by means of sucker rods (C. F. Abstract No. 1106). L. V. W. C.

1213. Small Motors Reveal Interesting Data on Power Costs. B. Mills. *Oil Weekly*, 16.10.33, **71** (5), 22.—The use of small electric motors in slow pumping operations has resulted in several interesting facts concerning electrical energy.

One of the surprising discoveries was that counterbalancing does not reduce power costs. In some cases a smoother action resulted which offset the slightly additional cost.

During the investigations it was discovered that the counterbalances functioned properly for a short part of the stroke only. On the down stroke the small motors forced the pump downward through the fluid and consequently caused them to lift the counterbalances. The counterbalances created a kind of leverage which worked against the small electric motors. These results have been obtained when lifting heavy and viscous oils. With light oils it is possible that counterbalances would operate to advantage. L. V. W. C.

1214. Design of Air-Gas Lift Compressor Plants. L. G. E. Bignell. *Oil & Gas J.*, 12.10.33, **32** (21), 49.—Due to the fact that the wells in the Oklahoma City Field often produce up to 90% of salt water with the oil it is necessary that the compressor plant for dealing with the gas for gas lift operations be so designed as to give the highest efficiency possible. Flexibility in operating conditions is also necessary to allow the plant to accommodate itself to the altered conditions at the wells.

Kick-off pressures of 1500 lb./sq. in. are necessary with operating pressures of 750 lb./sq. in. for normal conditions. In order to build up 1500 lb. pressure the compressors are so arranged that two 5½ by 20 in. stroke cylinders in the two end compressors can build up the 750 lb. normal working pressure to the high pressure necessary for the kick off.

The wet gas from the wells is delivered to the plant at about 10 lb. pressure and is passed through the scrubbers, where foreign matter is removed. From the scrubbers the gas passes through the header to the low side cylinder on the compressor and is compressed up to 72 lb. The compressed gas is then passed to the coolers and thence to the first stage accumulators, which are working under pressures of about 70 lb. The gas is then passed through the intermediate cylinders, where it is compressed to 290 lb., and thence to the high pressure cylinders, where it is compressed to 750 lb./sq. in. The gas is then delivered to the well head connections.

The plant is so designed as to permit the casing head gasoline which is produced during compression to be removed and passed to storage tanks.

A number of novel features incorporated in the plant are explained. L. V. W. C.

1215. Well Pressure Injects Chemical in Control of Paraffin Deposit. Anon. *Oil Weekly*, 16.10.33, **71** (5), 24.—In order to remove the paraffin which is deposited in the tapered tubing of the wells in the Judkins Field, Texas,

the wells have been fitted with a device through which chemical is blown into the tubing with beneficial results.

The chemical is introduced into the tubing through a 500-foot string of 1-inch line run into the top of the tubing string and packed off at the tubing head. Outside the derrick is placed a cylinder in a horizontal position and four connections are welded to the cylinder. The outlet is to the 1-inch chemical string at one end, the mixing swedge nipple and drain at the other end, and the pressure control inlet near the middle. The chemical, Kontal, is placed in the cylinder with a supply of oil which has been taken from the flow line from behind the choke through a ¼-inch line. The casing pressure is greater than the tubing pressure, so that a connection from the control head to the chemical cylinder through a ¼-inch line introduced at the pressure nipple supplies pressure for introducing the chemical mixture into the tubing.

L. V. W. C.

1216. Contribution to the Study of Oil-Field Water Analysis. A. H. K. Radjy and C. E. Wood. *J. Inst. Petr. Techn.*, 1933, **19**, 845–862.—An account of a comprehensive examination of the method of estimating sodium by the dihydroxytartrate method. G. R. N.

1217. Treatment of Emulsions and Reclaiming Oil from Crude Tank Bottoms. F. Swindell. *Oil Weekly*, 16.10.33, **71** (5), 16.—Most of the earliest methods for reclaiming a portion of the oil which had previously been lost through emulsification resulted in large losses through evaporation of the lighter fractions into the air since emulsions were heat-treated in open tanks.

The latest method is a closed system in which all vapours driven off during the treating process are charged back into the clean oil stream at pressures only slightly above atmospheric.

The viscosity of the emulsion is lowered and the chemicals are activated by the application of temperatures ranging from 140° to 250° F. Depending upon the type of crude treated, it is estimated that up to 12 per cent. of the material under treatment can be vaporised.

Emulsion is drawn from the stock tank by pumps, the chemicals being injected into the stream at the suction end of the pumps. The stream is heated in a coil, and then passes into two specially constructed treating tanks where the chemicals act to permit rupture of the oil film. Water and sand drop to the bottom, and the lighter fractions pass off at the top of the treating tanks, through a condenser and back into the clean oil stream in the form of liquids. L. V. W. C.

1218. Acid Makes Flush Producers Out of Many Dead Oil Wells. Anon. *Wall St. J.*, 14.10.33.—The revival of oil production in thousands of dead and marginal wells on a scale equal to or in excess of their original flow is foreseen by the research committee of the American Petroleum Geologists. The restoration of dormant pools to flush production will be brought about by the treatment of the wells with hydrochloric acid, according to a report of the geologist of the Humble Oil and Refining Company. The Research Committee consider that the future cost of obtaining oil will be reduced by one-third, and that many millions of barrels of oil formerly considered lost will be recovered. W. W.

1219. Acid Treatment of Limestone Wells. M. E. Chapman. *Oil & Gas J.*, 12.10.33, **32** (21), 10.—The acid treatment of limestone reservoirs has become a common practice in the Mid-Continent area and Michigan Fields.

Limestone reservoirs react to this treatment much more favourably than any others, even though the formation may contain calcareous material.

Hydrochloric acid of varying concentrations is the principal agent used since the products of the chemical action of hydrocloric acid on pure limestone and dolomite are water soluble residues and gas.

An inhibitor is added to protect the casing and tubing from attack by the acid. L. V. W. C.

1220. Repressuring Wells with Air and Gases. R. C. Conine. *Oil & Gas J.*, 12.10.33, **32** (21), 9.—The procedure adopted by the South Penn Oil Co. of Pennsylvania is outlined in this article. Repressuring has been carried out with a mixture of air and gas on account of the lack of gas pressure on the property after a comparatively short period, and operators are urged to give air, natural gas and/or inert gas repressuring a trial.

The method of operation is to clean out and insert a packer in the hole in such a position that the gas is reasonably certain to enter the sand to be repressured. Each pressure well is equipped with a check valve above ground and a meter for measuring the gas.

The gas is started into the well at a pressure that just permits its entry into the sand and the pressure then slowly increased. A constant check is kept on the input volume as compared with the production of oil for the area which the pressure well is designed to serve, and this volume is maintained as low as possible.

The oil-gas and fluid-gas ratios are determined, and by this means it is possible to keep a check on the field for gas movements in the sand and so anticipate possible channelling or short circuiting. L. V. W. C.

1221. Behaviour of Restricted Wells. Anon. *J. Inst. Petr. Techn.*, 1933, **19**, 863–877.—An account of a discussion held by the Trinidad branch on a report of an open discussion by the Rumanian branch upon the behaviour of restricted wells. G. R. N.

1222. Patents on Crude Oil.—A. M. Herbsman. U.S.P. 1,931,112, 17.10.33. A method of treating petroleum emulsions in which the latter are mixed with chlor-amine toluene and the mixture allowed to stand to permit of stratification.

H. F. Fisher. U.S.P. 1,932,093, 24.10.33. Emulsions are resolved by passing them between two relatively moving bodies. One of the latter is preferentially wetted by one phase of the emulsion and the other preferentially wetted by the second phase. W. H. T.

Class 400. Transportation, Storage and Distribution.

1223. Protecting Underground Pipe Lines against Soil Action. K. H. Logan. *Chem. Met. Eng.*, 1933, **40**, 514–516.—For 11 years the U.S. Bureau of Standards have conducted an investigation of the relation of soils to corrosion and in this article some tentative conclusions are drawn as to the nature and mechanism of underground corrosion. Corrosion is probably always an electro-chemical phenomenon the relative influence of the various factors affecting its rate of progress depending upon the conditions under which it takes place. The data indicate quite definitely that all of the commonly used ferrous pipe materials corrode at nearly the same rate under the same soil conditions. On the other hand, both the rate of corrosion and the form and distribution of the corroded areas differ widely for different soils and appear to be characteristic of the soil. It seems quite probable that the potential differences which cause most of the corrosion underground are the results of variations in oxygen supply at different points on the surface of the buried

metal. The chemical characteristics of soils seem to have a direct effect on their corrosiveness and on their physical characteristics, a function of the latter being the area of the anodic and cathodic surfaces. Field data and observations of corrosion of working pipe lines show that the rate of pitting decreases with time under most soil conditions. As differences in local conditions along the pipe surface appears to be the primary cause of corrosion, it seems probable that a continuous coating which serves only to maintain uniform conditions with respect to the pipe surface might be satisfactory. One way to reduce corrosion is to use a metal the natural corrosion products of which inhibit further attack. Copper bearing steels and stainless steels are examples of such metals. Iron chromium alloys have and are now being tested and the results are showing great promise. Zinc coated pipes appear to withstand corrosive influences better than lead coated pipes. Of inorganic non-metallic coatings well made and properly applied cement mortar has proved effective. The most extensively used pipe coatings have bituminous bases. These latter materials are usually reinforced with felt or woven fabric. A disadvantage of bituminous coatings is that they rarely give a continuous covering and moisture is able to pass through minute pores to the pipe. Their advantage seems to lie in their ability to maintain uniform oxygen and moisture distribution at the pipe surface, thus minimising the number and potentials of the electrical circuits set up. One of the reasons for the rather slow development of satisfactory pipe line protection has been the lack of satisfactory methods for determining the performance or condition of coatings.

G. R. N.

1224. Vapour Gathering Systems with Steel Balloons Reduce Losses. L. G. E. Bignell. *Oil & Gas J.*, 12.10.33, **32** (21), 8.—It is recognised that if fresh air can be kept from passing over petroleum products that evaporation would be reduced to a minimum.

In addition to the usual precautions such as floating roofs, breather roofs, etc., a steel balloon has been used with success. This balloon is placed in a closed system of large pipes connected with the tanks and takes care of the expansion and contraction of vapour or gas due either to thermal expansion or actual liquid displacement.

The principle upon which the balloon is based is the well known tendency of a vessel to try to assume a spherical shape when subjected to internal pressure.

The roof of the balloon in the normal position rests upon the bottom. When gas is forced into the balloon the top rises and the bottom assumes the shape of a saucer. In the roof is placed a volume control to prevent rupture should excess gas be forced into the balloon.

L. V. W. C.

1225. Pumping Unit. A. M. Rowling. *Oil & Gas J.*, 12.10.33, **32** (21), 33–48.—A special section has been devoted to a detailed description of the Rannett motor-driven centrifugal pumping unit.

Among the many interesting features of this unit is the method of cooling the motor. The gasoline is circulated in the annular space between the motor casing and a steel jacket and by this means the electric motor supplying power to the unit is cooled.

The design of the unit is such that it can be incorporated into a series operated station which will give it flexibility.

The unit can be supported by the line itself and needs practically no foundations. In addition it can be assembled in the shops and moved to the final location ready for operation immediately.

L. V. W. C.

Class 500. Properties and their Determination.

1226. Ozone, Knock-Inducer Extraordinary. D. B. Brooks. *J. Inst. Petr. Techn.*, 1933, **19**, 835–844.—Interesting experiments are described on the effect of ozone on fuels under test in a C.F.R. engine. It is shown that this effect is of a profound detonating character. G. R. N.

1227. New Oil-Testing Machine. Anon. *Automobile Engineer*, 1933, **23**, 427.—The Maschinenfabrik Augsburg-Nürnberg A.-G. has manufactured a new friction-testing machine for lubricating oil examination. The friction is autographically recorded under conditions that vary from: (1) specific loads of 0·5 kilogram per sq. cm. to about 100 kg. per sq. cm. and over; (2) rubbing velocities of a few metres to a few hundred metres per minute; (3) temperatures of 15 to 200° C. (either by gradually warming or by cooling). The wear of the test piece may be recorded also.

The machine consists of a hollow cylinder of hardened steel mounted on a main shaft, heating being effected inside the cylinder; on this rests a test piece attached to a lever which is weighted. The temperature of the test piece is measured close to the point of contact by a thermocouple. The friction developed throws the frame of the machine out of the vertical, the angle of displacement being measured by a pointer and scale. Comparisons of the readings obtained under conditions of forward and backward rotation of the cylinder give a check on the adjustment of the machine.

Typical friction-temperature diagrams are illustrated. C. I. K.

1228. Action of High Temperatures on Mineral Oils. M. Ribagnac. *Ann. des Comb. Liq.*, 1933, **8**, 875–882.—The work described in this paper was undertaken to confirm a theory put forward to explain an accident which occurred with a Diesel engine operating in a closed room. Apparently, lubrication failure in the transmission gear caused sufficient heat generation to decompose the lubricating oil; the gaseous products so formed escaped and gave an explosive mixture with the air, which was ignited. A successful method of ascertaining the effect of heat upon a lubricating oil (recommended for use with Diesel engines) was to drop the oil slowly upon a nichrome wire, kept at 700° C. (approx.), contained in a flask, with arrangements for admitting air and removing the products of the reaction. In the presence of air, oxidation products, *e.g.*, aldehydes, were formed. The reaction was allowed to proceed in the absence of air, and the gas obtained was found to consist substantially of acetylene (31·3%) and hydrogen plus saturated hydrocarbons (55%), with small amounts of carbon dioxide, etc. The oil which collected in the bottom of the flask, after contact with the hot wire, was practically identical with the original oil, but possessed a strong odour.

The limits of the explosive mixture of the gas with air were determined and found to be between 7·8 and 18% of gas. Similar data for explosion with oxygen are given. W. E. J. B.

1229. Effect of Automobile Engine Design on Octane Number Ratings of Motor Fuels Used. W. H. Hubner and B. Murphy. *Oil & Gas J.*, 21.9.33, **32** (18), 15.—An analysis of the road tests carried out in connection with the development of the C.F.R motor method of determining antiknock rating shows the big differences in road ratings which exist between cars operating on the same fuel. These differences are primarily a function of combustion-chamber temperature. Detonation bears a direct relationship to the temperature of the charge immediately before ignition and to the temperature of the last portion burned. Lowering of both temperatures is therefore desirable. Combustion chamber temperature is affected principally by

four factors of engine design, *viz.*, combustion-chamber design, cooling efficiency, volumetric efficiency and number and size of cylinders. The four types of combustion chamber design in general use are: conventional L-head, Ricardo-type L-head, conventional valve-in-head and modified valve-in-head. Each is briefly described. The last mentioned is the nearest practical approach to the ideal combustion chamber. A test car powered by an engine of this type showed the road rating for a cracked gasoline to be even higher than the Research Method rating. The pent-roof type of chamber is, however, more costly and less convenient from a mechanical point of view, and is therefore seldom used. The Ricardo-type L-head is superior from the standpoint of detonation and fuel depreciation to the remaining two types. Substitution of cast iron cylinder heads by aluminium ones has been found to enable the use of compression ratios approximately one unit higher for the same fuel, thus giving increased horse power and reduced fuel consumption in the same engine. The problem of improving cooling efficiency is one of great importance since knocking tendency can be materially reduced and permissible power output increased by more efficient cooling. Data obtained on a C.F.R engine shows that by decreasing the temperature of the gasoline/air mixture entering the cylinder from 300° F. to 100° F. an increase of 35% in power output was obtained at 900 r.p.m. when the C.R. was adjusted for max. power and the carburettor for max. detonation in each case. The octane rating of a cracked gasoline was improved by four numbers as a result of the reduction in mixture temperature. Improvements in jacket cooling do not appear to be of great importance as a lowering of the cooling water outlet temperature of the same engine from 212° F. to 100° F. increased the fuel rating by only two octane numbers and the power output by 2%. This was further confirmed by tests on a Chevrolet engine. Internally cooled exhaust valves, however, were found to increase the max. power output by 8% in a single-cylinder engine, and, by cooling the underside of the piston with large quantities of soapsuds, a further increase of 25% was obtained.

High volumetric efficiency permits greater power output and decreases the tendency of fuels to detonate and depreciate in antiknock value as evidenced by the road tests and by tests carried out in an S30 engine. The reduction in detonation tendency is due to decrease in percentage of exhaust gas mixed with fresh charge, and consequent lowering of the temperature of the charge before ignition.

Since small pistons permit a higher ratio of cooling surface to piston diameter, the present tendency to use a greater number of cylinders of small bore seems desirable from the standpoint of knocking tendency and depreciation of fuels.

During the last few years the increase in specific power output of engines has been accomplished in most cases by increases in compression ratios and pressures. This has placed a heavy burden on refiners in producing fuels of increased antiknock value. It is quite possible for engine builders to increase the power output and efficiency of engines by the means described in this article, and the use of these methods will go a long way towards solving the fuel problem. R. A. E.

1230. Oxidation of Paraffin and Ceresin. K. Typke. *Erdöl u. Teer*, 1933, 9, 451.—In a note on the paper by Reiner (Abstr. No. 1140) Typke points out that the oxidation characteristics of a single paraffin cannot be used to characterise paraffins as a class, since the behaviour varies very much.

Some figures are quoted for oxidation results after blowing air through paraffins from petroleum and brown coal tar, the conditions being 120° for 70 hours.

In one case for each class of product, there was practically no tar or acid number developed, while in other cases, very considerable amounts of oxidation products were formed. E. B. E.

1231. Naphthenic Acids in Petroleum. E. Pyhala. *Matt. Grasses*, 15.9.33 (305), 9942–44.—When Balakhany and Emba crude oils were distilled it was found that the acidity of the total distillates was 10–12 times greater than the acidity of the original crude oils. A similar result was given by light Rumanian fuel oil. This, it is suggested, may be due to the masking of the naphthenic acids in the crude oil by complex substances which are decomposed during the distillation so that the acidity of the total distillates is a more reliable criterion of the naphthenic acid content of the crude oil than the acidity of the oil itself. A study was also made of different solutions of naphthenic soaps and other products obtained by preliminary alkaline treatment of petroleum fractions. The alkaline extract of a kerosine distillate from Tscheleken crude was separated into a clear solution of naphthenic soaps and a yellowish brown flocculent precipitate by dilution with water. The naphthenic acids were liberated from the solution by hydrochloric acid and had a sp. gr. at 15° C. of 0.9893 and an acidity number of 236. The flocculent precipitate was dried in a porcelain dish and boiled with strong hydrochloric acid. A yellow acid solution containing iron and a black oily residue were obtained. This residue, purified by ether extraction, has a sp. gr. of 0·8618 and an acidity number of 67·6; its odour was different to that of naphthenic acids. Examination of an alkaline extract of refined Baku motor spirit showed that this fraction contained no naphthenic acids. The 150°/166° C. fraction of cracked distillate from Baku crude was oxidised by refluxing with dilute nitric acid. The aqueous acid layer was made alkaline and evaporated to dryness. It was then extracted with alcohol. The alcohol extract on distilling over the alcohol gave an oily residue. The latter was treated with soda and the soda extract so obtained yielded an oil on acidification. This oil had the same odour as the naphthenic acids extracted from Baku kerosine; its boiling range was 230°/260° C. and it gave a high acid value. The above experiment suggests that naphthenic acids may be formed in petroleum as the result of oxidation reactions. G. R. N.

1232. Catalytic Polymerisation of Propylene. F. H. Gayer. *Ind. Eng. Chem.*, 1933, **25**, 1122.—An account is given of the influence of catalysts on the polymerisation of propylene at elevated temperature (340–350° C.) and at atmospheric pressure. Of the catalysts tested, Floridin was found to have the desired properties. Based on the results obtained with Floridin, synthetic catalysts were developed.

In the experiments described, propylene was passed through a flowmeter, drying towers, Pyrex reaction tube containing the catalyst, and thence through two condensers at 0° and −25° C. respectively.

After the preliminary investigation, three different catalysts were used: (1) Floridin dehydrated by four different methods; (2) synthetic aluminium silicate; and (3) alumina adsorbed on silica. Details are given of the preparation of these catalysts. Synthetic aluminium silicate was found to have approximately the same activity as the best activated Floridin. Synthetic ferric and magnesium silicates and precipitated silica were inactive. Alumina-on-silica possessed an activity approximately twenty times that of the best activated Floridin. It was observed that the activity and life of the catalysts were increased if traces of hydrochloric acid were present in the propylene, and this was conveniently generated by the decomposition of a small quantity of alkyl chloride introduced with the propylene. Curves are given which show the change of catalyst activity with time. With

propylene containing 0·3% by volume of *n*-amyl chloride, the initial activity of alumina-on-silica decreased to about one-half in 7 days.

The surface of the catalysts after use, showed indications of the presence of carbon, and also contained a substance soluble in organic solvents and recoverable from acetone solution as a tough resin. By removing this soluble substance with acetone it was possible to reactivate Floridin, but alumina-on-silica required the same activating method as that used in the preparation of the fresh catalyst. Recirculation of the propylene was tried and an 80% conversion to liquid polymer, by weight, was obtained.

The nature of the product of polymerisation using the three catalysts was approximately the same, viz., a liquid of specific gravity 0·7, n^{20}_D 1·405 to 1·410 and bromine number 150 to 155. Steam distillation of the crude polymer gave 90% as a colourless, practically gum-free, highly volatile fuel. The octane numbers (C.F.R. research method) were 91 and 87 for the crude polymer and for the 90% steam distillate respectively. The liquids boiling up to 150° C. were shown to consist of a series of homologous olefines from C_5 to C_9 inclusive and a small portion of paraffin hydrocarbons.

Large quantities of water decreased the activity of Floridin, while traces of moisture were sufficient to give signs of poisoning with alumina-on-silica. All the catalysts were extremely sensitive to the slightest trace of alkali. Oxygen appeared to be another strong catalyst poison. E. N. H.

1233. Preparation of Pure Triethanolamine. F. E. E. Germann and O. S. Knight. *J. A.C.S.*, 1933, **55**, 4150.—Pure hydrochloride of triethanolamine (β,β',β'',-Trihydroxytriethylamine) is prepared by carefully neutralising the commercial product, with or without preliminary fractional distillation, with concentrated hydrochloric acid at 10–15° C. Very slight excess of acid, as shown by litmus paper, is added. In an hour, pure white crystals have settled out. These are filtered off with suction and thoroughly washed with 95% ethyl alcohol, then dried at 110° C. for an hour. Yield—70% of triethanolamine based on amount originally present. M.P. 177–178° C.

The conversion of the hydrochloride to the free base with silver oxide or alcoholic solutions of sodium or barium hydroxide is difficult because of the solubility of the chlorides in the base or its ethyl alcoholic solution. The following method is successful, however. 100 gr. of the hydrochloride are added to 400 ml. of isopropyl alcohol, to which an equivalent quantity of pulverised sodium hydroxide has been added. This mixture is refluxed for three hours on a water bath and, after standing overnight, the precipitated sodium chloride is removed on a suction filter. The alcohol is distilled off at atmospheric pressure, after which the triethanolamine is distilled over at 194–195° C. at 10 mm. A 90% yield of odourless, pale straw coloured oil is obtained. Sp. gr. 20° C/20° C. 1·1239, purity 99%. W. E. J. B.

1234. Synthesis of Hydrocarbons of High Molecular Weight. M. Lerer. *Ann. des Comb. Liq.*, 1933, **8**, 681–733.—A number of hydrocarbons of complex structure, both aromatic and aliphatic in type, have been synthesised and their properties determined. The viscosity curves have been determined in the case of the liquid members as part of a general investigation by Hugel and collaborators on the relation between viscosity and structure.

Various anthracene derivatives have been prepared by means of the di-sodium compound obtained by treating anthracene in, *e.g.*, ether solution, with metallic sodium. By the action of alkyl chlorides dialkyl-dihydro-anthracenes were then obtained, *e.g.*, the diethyl-dihydro-anthracene (viscosity 1·57 poises at 20° C.), the diisoamyl compound (viscosity 50·86 poises

at 20° C.), the diisooctyl compound, etc., etc. These are very viscous liquids at ordinary temperature, but the viscosity falls very sharply on heating.

As by-products and also by dehydrogenation of the dihydro-dialkyl-anthracenes, the dialkyl-anthracenes are obtained. These are solids of high melting-point, *e.g.*, diethylanthracene (melting-point 145°), diisoamyl-anthracene (melting-point 134° C.) and diisooctyl-anthracene (melting-point 65° C.).

Several naphthalene derivatives were obtained by similar means (the reaction with sodium being carried out in liquid ammonia solution), *e.g.*, 1·2·3·4· tetrahydro 1·4 diisobutylnaphthalene and diisobutylnaphthalene. The former has a viscosity of 0·403 poises at 20° C. and the latter of 0·476 at the same temperature. Diisobutyldinaphthyl, produced by similar means, is a solid melting at 80–81° C.

A number of branched chain olefines and paraffins containing up to 48 carbon atoms have been obtained by means of the Wurtz synthesis starting from an octyl alcohol, prepared by the decomposition of castor oil soap and its condensation products.

These liquids have much lower viscosities than the cyclic compounds previously prepared, the methyl-β-octyl-tetracosylenes ($C_{33}H_{64}$) having a viscosity of 0·176 poises at 24° C. and a dimethyl-tetrahexyl-docosane ($C_{42}H_{86}$) showing 1·61 poises at 25° C. E. B. E.

1235. Solubility of Hydrogen and Natural Gas at High Operating Temperature and Pressure. V. Ipatieff, V. P. Teodorovitch and I. M. Levine. *Oil & Gas J.*, 5.10.33, **32** (20), 14.—Since the rate of reaction between liquids and gases in hydrogenation only reaches its maximum when the liquid is saturated with the gas, it is important to know the co-efficients of solubility of hydrogen under pressure and high temperature in light and heavy oil fractions.

Preliminary determinations were carried out with natural gas in kerosine and mazout, as the residual gases from hydrogenation contain large quantities of methane. The amount of gas dissolving in the liquid was determined by thorough mixing in a high pressure bomb and removing a sample into a gas burette.

The solubilities of hydrogen in benzole, toluol, xylol and mesitylene at 25° C. and 40° C., and in benzole at 100° C. were determined at pressures up to 319 atmospheres, and have been tabulated. The curve showing the effect of pressure on the solubility of hydrogen indicates that the solubility of hydrogen increases with pressure and temperature, and also that the co-efficient of solubility decreases with increase of methyl group in the benzole. A series of determinations of the vapour pressures of gasoline and kerosine at various temperatures was made in connection with an examination of the solubility of hydrogen in petroleum fractions at various temperatures and pressures. It is concluded that the solubility of hydrogen in gasoline, kerosine, cylinder oil and paraffin base mazout follows Henry's Law, while with increase in temperature the solubility is increased and the temperature co-efficient remains positive. With increased hydrocarbon molecule the co-efficient of solubility decreases.

For determining the solubility of methane, natural gas containing 61·1% of methane was taken, and a similar series of experiments showed the solubility of nitrogen in kerosine, as well as in mazout increased with increasing temperature from 100° to 240° C., while the solubility of methane decreases with increasing temperature.

Full descriptions of the apparatus used and the results obtained are given. C. L. G.

1236. Determination of Sulphur Contents by the Lamp Method. A. R. Choppin and R. L. Menville, Jr. *Nat. Petr. News*, **25** (39), 19–22.—It is stated that the present A.S.T.M. D.90–26T Method for the estimation of sulphur has several drawbacks which are due to inherent shortcomings in the design of the lamp. The two principal faults in the lamp, each leading to carbon formation on the chimney and/or wick, are stated to be (1) The diameter of the A.S.T.M. lamp chimney is so small that if sufficient draught is employed to prevent carbon formation, then the velocity of the air through the chimney is so great as to render proper flame adjustments impossible; and (2) owing to the construction of the lamp, heat is transmitted to the burner from the chimney. As the burner becomes hotter, the length of the flame increases until often the flame tip is sucked right through the chimney. The L.S.U. lamp has been designed to eliminate these difficulties. The improved lamp leaves the A.S.T.M. lamp essentially the same, but fits a larger chimney. Overheating of the burner is prevented by fitting to the burner stem a metal radiator. Constructional details of this radiator and the dimensions of the modified chimney are given. Tables given in the article show that the rate of burning in the L.S.U. lamp is twice that in the present A.S.T.M. lamp. The results of tests conducted on gasolines prepared by adding known quantities of sulphur bodies to sulphur-free gasoline indicate that the results are strictly reproducible, and that the deviation from theory is less than in the case of the A.S.T.M. lamp. H. G.

1237. Chlorinated Paraffin I. F. T. Gardner. *Ind. & Eng. Chem.*, 1933, **25**, 1211–1213.—Commercial paraffin was chlorinated at 70° C. and compounds containing a chlorine content varying from 20–48·5% of chlorine obtained. Difficulties were encountered when chlorinating beyond a 40% chlorine content. The densities and viscosities of the samples were determined at 37·8° and 100° C., also the pour point, surface tension and molecular weight. The results showed that polymerisation occurred to a very slight extent, if at all. W. S. E. C.

1238. Test Methods for Petroleum. G. B. Murphy and C. Wirth. *Nat. Petr. News*, **25** (35), 16.—Three methods are outlined, namely (*a*) an improved method of gas analysis employing a modified Orsatt apparatus; (*b*) a colour stability test for gasolines, utilising ultra-violet light from naked carbon arcs; and (*c*) a method for estimating the gasoline content of gases in which liquid nitrogen is used for condensing.

The apparatus used for gas analysis consists of two sections, an absorbing system on the Orsatt principle but with certain modifications which overcome the difficulties met in the original apparatus, and two tubular electric furnaces for the combustion of the gases. The first tube is packed with finely ground copper oxide with 1% cerium oxide and maintained at 275° C. for the combustion of hydrogen. The second tube is packed with platinised asbestos for the combustion of paraffin hydrocarbons at 900° C. Pure oxygen is generated electrolytically within the apparatus in a cell containing an 18% KOH soln. and nickel electrodes.

In the colour stability test gasoline samples in quartz tubes are placed in a water-cooled compartment around a cylindrical shield surrounding the arc. The arc carbons are specially prepared to give a radiation rich in ultra-violet rays. It is claimed that 15 minutes' exposure in the lamp is equivalent to 2 hours noon June sunlight.

In the third method the gas is freed from moisture and passed into a condensing system at the temperature of liquid nitrogen (—195° C.). The condensate is weighed and fractionated at —105° C. a temperature at which methane, dissolved nitrogen and other difficultly condensible gases are removed. The vapour pressure of the residue is determined at a known

temperature. Then from a curve relating the specific gravities and vapour pressures of the pure hydrocarbons at the same temperature, the sp. gr. of the gasoline condensed is determined.

It is claimed that the method yields results comparable with those obtained on rich gases with the Pobneilniak apparatus, and with a gas containing less gasoline the results are more reliable than with the latter apparatus. H. G.

1239. Filling Compounds. H. Mallison. *Asphalt u. Teer*, 1933, **33**, 765–767.—Proposals for the modification of the DIN Specification for these mixtures are discussed. It is emphasised that it is not sufficient to specify particle size of the filler or the proportion of bitumen and filler, the properties of both filler and binder must be considered. Asphaltic bitumen, tar and soft pitch can be used, but all samples of the latter are not completely miscible with asphaltic bitumen and the heterogeneous mixtures are unsuitable.

Formulæ are given and discussed for various mixtures used in practice, in some of which the proportion of filler exceeds the DIN specified amount. By suitable choice of binder, however, satisfactory products can be made.

It is hoped that the new specification for jointing material for earthenware pipes will be modified as regards the fillers which may be used, since, for example, brown coal ash is of very irregular composition and may contain water-soluble material. With these products the presence of a high proportion of high-boiling phenols (as plant poison) to prevent penetration by roots is essential. Water soluble phenols and cresols should be excluded. A formula is given. C. C.

1240. Freezing-out Method for Gasoline Analysis of Refinery Gases. J. L. Oberseider. *Nat. Petr. News*, **25** (37), 35.—A rapid method for the determination of the gasoline content of refinery gases is described. A graduated 2-gal. gas sample bottle is connected to a condenser immersed in a bath of solid CO_2 and gasoline. The condenser is of special design, which is described. 5000 ml. of the gas are displaced by water through the condenser, at the rate of 250–300 ml. per minute. The condenser is then removed and the volume of the condensate is read. Reference to a curve then gives the content of propane and heavier bodies. The condenser is allowed to warm up in the air, and is then immersed in a bath maintained at 15–16° F. until boiling ceases. The volume of the residue is then read, and reference to a second curve gives the content of butane and heavier bodies. H. G.

1241. Limits of Inflammability of Natural Gases Containing High Percentages of Carbon Dioxide and Nitrogen. G. W. Jones and R. E. Kennedy. *U.S. Bur. Mines R.I.* 3216, June, 1933.—It has been shown that from a knowledge of the composition of a combustible mixed gas and of the limits of inflammability of the individual components, the limits of inflammability of the mixed gas and air could be calculated from a modification of le Chatelier's law, which in its simplest form is as follows :—

$$\text{Limit} = \frac{100}{\frac{P_1}{N_1}+\frac{P_2}{N_2}+\frac{P_3}{N_3}\ldots}$$

where P_1, P_2, P_3, etc., are the proportions of each component, and N_1, N_2, N_3, etc., the limits in air for each component.

This law does not hold good in the presence of C_2H_2, C_2H_4, H_2S, or chlorinated hydrocarbons, nor of more than 1% of inert gases. The le Chatelier law has been modified so as to enable the limits of inflammability of natural gas containing carbon dioxide and nitrogen to be determined. Extensive data on the inflammability limits of methane, ethane, propane and butane in nitrogen and carbon dioxide have been obtained using a vertical 2 in.

tube 6 ft. long, the flame being propagated upwards. The results are tabulated and also shown graphically. The modification of the le Chatelier law to enable the inflammability limits of such mixtures to be calculated consists of combining the data for the nitrogen and carbon dioxide with that of the different combustibles. Thus in a mixture of methane, ethane, carbon dioxide and nitrogen, the mixture is divided into two components, *e.g.* (1) methane and carbon dioxide and (2) ethane and nitrogen. Then the limits of combustibility of each component—consisting of the inert and combustible gas—are read off from the tables (prepared from the results given by this investigation), and the le Chatelier law applied to the whole system, which is considered as being composed of two combustible components. A check is obtained by dividing the mixture into different components, *e.g.*, methane and nitrogen and ethane and carbon dioxide. Calculated results agree to within 1% of the determined values on widely varying mixtures of methane, ethane, nitrogen and carbon dioxide. C. L. G.

1242. Viscosity of Natural Gas. W. B. Berwald and T. W. Johnson. *U.S. Bur. Mines Tech. Paper* 555 (1933).—It has been shown that the same general laws of fluid motion apply to an analysis of the flow of either liquids or gases, and a practical method has been developed from these laws for measuring the viscosity of natural gas. The method is based on the relationship between the friction factor and the Reynolds number for the flow of gas through circular tubing, a gas of known viscosity (dry air) being used to determine the constant for any tube of fixed dimensions. From this constant, together with measurements of the flow of gases of unknown viscosity through the tube, the viscosity of the gas sample may be determined with an experimental error of $\pm$ 1·25%. Determinations of viscosity have been made on 25 natural gas samples varying in type from a dry gas (mainly methane) to a wet casing-head gas, the maximum variation observed being 25 per cent. depending on the composition of the gas. Within the temperature range 40°–80° F., the viscosity increases approximately 7%, and it is considered that the same increase in viscosity extends over much wider ranges of temperature. W. H. T.

1243. Action of Light on Cracked Spirit. E. Vellinger and G. Radulesco, *Ann. des Comb. Liq.*, 1933, **8**, 883–885.—In a note presented to the Academie des Sciences the authors describe experiments on the artificial ageing of cracked spirits by exposure to the light of the mercury-vapour lamp. The amounts of oxygen absorbed were measured and the gum formed was determined. The effects of certain inhibitors and sensitisers were examined by this means.

Up to 30 vols. of oxygen were absorbed by some samples; the amount of gum formed is proportional to the oxygen absorbed. The method is suitable for determining the efficiency of refining and the value of inhibitors.

E. B. E.

1244. Method for Gauging Sunlight Exposure Period to Determine Colour Stability of Gasoline.—E. C. Hoeman. *Oil & Gas J.*, 14.9.33, **32** (18), 18.—The ordinary method of exposing samples of petroleum distillates to sunlight in order to obtain information regarding colour stability only permits comparison of samples exposed at the same time under identical conditions, owing to the absence of information regarding intensity of sunlight during the test period. Taking advantage of the actinometric properties of ferric oxalate, a method has been devised to obtain a more direct indication of the test period endpoint, so that results obtained at different periods can be compared. The method recommended is to prepare a preliminary solution

containing 20% by vol. of C.P. H_2O_2 and 5 grs. of pure oxalic acid crystals per litre. The H_2O_2 prevents the reduction of ferric oxalate before the time of test, and the oxalic acid insures complete oxidation of ferrous salts, prevents precipitation of inoxidisable iron salts and promotes clean settling of ferrous oxalate in exposed cells. Using a pure sample of ferric oxalate hexahydrate, a solution containing a known concentration of ferric ion is prepared. Stock and cell solutions are prepared by red-light illumination and stored in the dark. About 12 hours before the time set for a test, cells are prepared by dilution of stock solution with peroxidised distilled water. Ferric ion concentrations of 0.10/0.25% by wt. were used in tests described. The cells are 4 oz. bottles identical with those in which oil samples are to be exposed, and both should contain volumes of 100 ml. Cells are wrapped in red crêpe paper, left unstoppered to stabilize the content of free oxygen and stored in dark until time of test. Preparatory to exposure, test should be made for the presence of ferrous ion with potassium ferricyanide, and care should be taken that there is no precipitated material within the cell. The cell and oil samples are exposed simultaneously, and all, as nearly as possible, normal to the path of incident sun rays. Progress of the reduction in cell units is tested from time to time by adding a few drops of solution to an identical volume of potassium ferrocyanide solution. When a blue discoloration and precipitate just fail to appear, the cell solution has been reduced and the end-point reached. This endpoint is well defined. Tests carried out in June and July under varying weather conditions show wide variations in the time required to reduce ferric oxalate solutions of equal concentration.

R. A. E.

1245. Chemical Nature of Gum-Forming Constituents in Gasoline. D. T. Flood, J. W. Hladky and G. Edgar. *Ind. Eng. Chem.*, 1933, **25**, 1234.—In order to determine the origin of gum in cracked motor fuels, individual olefinic hydrocarbons have been added in various amounts to straight run gasoline and the mixtures subjected to storage and gum stability tests. The greatest gum formation was experienced in those mixtures containing aliphatic or cyclic diolefines or mono-olefines attached to a benzine ring. Large concentrations of aliphatic mono-olefines also formed appreciable quantities of gum. Gum formation is considered to be almost invariably associated with oxidation, for, by substituting nitrogen for oxygen in the bomb test, with certain samples, no drop in pressure was recorded during the normal test periods. The action of inhibitors has been shown to result in an increase of the induction period without apparently affecting the rate of oxygen absorption after the induction period was ended. A comparison of the results of storage tests indicates that no simple relation exists between the time of stability in storage and the length of the induction period shown by the bomb test, but a complete oxygen-bomb pressure curve may give indications of behaviour in storage.

W. H. T.

1246. Gum Deposits in Gas Distributing Systems. I. Liquid Phase Gum (Conclusion). A. L. Ward, C. W. Jordan and W. H. Fulweiler. *Ind. Eng. Chem.*, 1933, **25**, 1224.—It has already been shown that liquid-phase gum is a mixture of polymerised and oxidised hydrocarbons, styrene and indene having been identified as the parent substances of the major portion of the gum. The conditions influencing the character of the light oil produced in a water gas plant have been investigated, and it is stated that the influence of factors was not shown in the oil content of the gas after condensation but in the oil condensed out at the plant. That the presence of this condensate is a prerequisite of gum formation is shown by the relation between condensation and stoppages in gas distributing systems. Methods are discussed for

the prevention or control of liquid phase gum formation by reducing the contents of oxygen, mercaptans or gum forming hydrocarbons. Apart from refrigeration, compression is considered to be the simplest method, variations in the operation of the gas producing plant being impracticable. With a proper design of scrubbing tower, all hydrocarbons condensible from gas at 0° C. may be removed, but it is pointed out that heat treatment is liable to cause cracking of the lower boiling compounds accompanied by some polymerisation. With regard to the reduction of dissolved oxygen, it would not be practicable to produce an oxygen-free gas owing to the high cost of the reaction. Some control of gum formation may be obtained by the removal of mercaptans and a portion of the gum-forming hydrocarbons. Details are given of the results obtained by the use of a heated catalyst and also by contacting the gas with various strengths of sulphuric acid. Finally, the advantages of gum inhibitors (negative catalysts) for use in certain places, such as governors and dipping meters, have been outlined. W. H. T.

1247. "Startability" of Motor Fuels. W. A. Whatmough. *Auto. Eng.*, 1933, **23**, 371–374.—There are three factors limiting engine "startability," viz., mixture strength, revolutions to fire and mixture temperature. Easy starting may be defined as firing in 10 revolutions or less, while 20 revolutions represents the useful limit.

Increasing the mixture strength favours the production of an ignitable mixture, as also does increase of the volatility of the fuel. "Winter grade" fuels contain about 15% of added natural gasoline. Benzole also increases the ease of starting; mixtures of benzole and gasoline have better starting characteristics than either component alone.

"Startability" curves are given for a number of fuels, the data being obtained by the method developed by Hoffert and Claxton. In these curves, the number of revolutions to fire required with a given fuel are plotted against the intake temperature for various mixture strengths.

The useful limit of 20 revolutions is reached at 5:1 mixture strength under winter conditions for No. 1 gasoline, while the "easy starting" limit is about 3:1 under the same conditions. All fuels commercially obtainable give easy starting with very rich mixtures, *e.g.*, 2:1. The best compromise is probably 3½:1. E. B. E.

1248. Sulphur Compounds in Gasoline. R. Dubrisay. *Ann. des Comb. Liq.*, 1933, **8**, 871–874.—The corrosive effects of sulphur and certain sulphur compounds dissolved in gasoline have been examined. A strip of copper or silver, 5 x ½ cms. cleaned with glass paper, is suspended in a 20 ml. narrow necked flask containing 10 ml. of the gasoline to be examined so that 1 to 1½ cms. of the strip is immersed.

Solutions of sulphur have no action on silver in 12 hours, but the immersed part of the copper strip is turned blueish. The effect is noticeable down to 0·001%, and amounts between 0·01 and 0·001% may be distinguished by this means. Allyl sulphide behaves similarly, down to 0·0001% of sulphur in this form being detectable. Hydrogen sulphide gives grey-black to red colourations, the latter being obtained down to 0.00008 concentrations. Silver is also blackened by hydrogen sulphide solutions. Ethyl mercaptan gives reddish tints down to ·001%.

Thiophene and carbon bisulphide have practically no effects below about 0·1% to 0·2% concentrations.

It is suggested that the method can be used quantitatively for estimating certain types of sulphur compounds, by comparison of the effects with those of standard solutions. E. B. E.

1249. Investigation of Motor Lubricants. M. Freund and S. Thamm. *Petr. Z.*, 18.10.33, **29** (41), 1–13.—Complete analyses of Moreni, Mid-Continent and Pennsylvanian lubricating oils have been carried out and particular attention given to the determination of the absolute viscosity.

Different types of lubricating oils having the same viscosity at 50° C. were arranged in order of increasing specific gravity, and those manufactured in the same manner from the same crude oil were arranged in order of fractions of increasing specific gravity and viscosity. Mixtures of lubricating oils prepared from known components were compared with other oils having the same specific gravity and viscosity.

It was found on comparing lubricating oils of the same viscosity at 50° C. that the volatility of the oil, the slope of the viscosity curve and generally the quantity of sludge formed on oxidation increased with specific gravity, but the value for carbon residue generally decreased. It was also observed that for mineral oils of the same viscosity at 50° C. the viscosity curve and boiling range appeared to be determined by the specific gravity alone, regardless of whether the oils were mixtures of different components or natural products. The value for carbon residue and stability of the oil was influenced by asphaltic and asphalt-forming constituents. The Conradson coke, the content of hard asphalt and the colour intensity appeared to be dependent on one another for oils of almost the same specific gravity and viscosity. Constants based on temperature-viscosity relationship were different for each member of a group of lubricating oils prepared in a similar manner from the same crude oil, but the specific gravity—viscosity relationship was a constant for all oils of the same group.

It is considered that the following tests are sufficient as criteria for motor lubricants: viscosity at 50° C., specific gravity at 20° C., set point, asphalt content, coke value and colour intensity. W. S. E. C.

1250. Determination of the Consistency of Fluid and Semi-fluid Greases by means of the Gardner Mobilometer. E. W. Nelson. *Nat. Petr. News*, **25** (40), 25–29.—For the control of the consistency of greases whose penetration is too high for determination with the A.S.T.M. cone penetrometer, the "Gardner Mobilometer" has been found to give reliable and reproducible information. The apparatus consists of a brass cylinder 1½ in. diameter and 8½ in. long. The bottom is removable to facilitate cleaning. The cylinder is screwed into a heavy base fitted with levelling screws. A plunger fitting into the cylinder consists of a rod 20 in. long and terminating at one end with one of three interchangeable discs. These discs are solid, bored with 51 small holes and 4 larger holes, respectively. At the other end of the rod is a small pan on which can be placed weights. Thus by a combination of a particular weight and disc the instrument can be made suitable for testing greases representing a wide range of consistency. In operation, the cylinder is filled to a mark with the grease, brought to a standard temperature, and the rod, which runs in a guide to ensure vertical travel, is fixed with the disc in contact with the surface of the grease. The rod is then liberated and the time is determined for the disc to reach the bottom of the cylinder. H. G.

1251. Consistency Control of Soft and Stringy Greases. E. R. Lederer and E. W. Zublin. *Nat. Petr. News*, **25** (37), 36.—Greases of the semi-liquid type, whose consistency renders the measurement of that property difficult in the Furol viscometer or the penetrometer, may be examined satisfactorily by means of a falling sphere viscometer. In the particular case under review, transparent greases were in use and no trouble was, therefore, experienced in determining the termination of the ball's travel. The grease is maintained at constant temperature in a cylinder of suitable dimensions.

The ball is held centrally over the cylinder by means of an electro-magnet, and the time for the ball to reach the bottom of the cylinder after the magnet circuit is broken is taken.

In order to determine the "liveryness" of a grease, the "String Test" has been devised. An A.S.T.M. grease penetration cone is immersed in the grease, at constant temperature, up to the point of junction of the cones. The cone is then lifted until its tip is 1 in. above the grease surface. A thread of grease, of decreasing thickness, runs from the cone, and the time required for this string to break is called the "string." Both tests are claimed to be invaluable as control methods in manufacture. H. G.

1252. Determination of Lead in Greases. A. D. Bauer and C. S. Ford. *Nat. Petr. News*, **25** (37), 37.—10 grm. of grease are carefully ignited in a porcelain crucible and allowed to burn to dryness. The residue is covered with conc. H_2SO_4 and heated to fuming, the process being repeated. The residue is now moistened with conc. H_2SO_4 and a few drops of conc. HNO_3 and heated to fuming, the process being repeated until the residue is white. The contents of the basin are then treated with ammonium acetate solution until all lead sulphate is dissolved. Any lead hydroxide formed is dissolved by the cautious addition of acetic acid. The solution is filtered and washed with 15% acetic acid, and finally with hot water, until free from lead. Dilute sulphuric acid is added until the precipitation of lead sulphate is complete. The solution is boiled free from acetic acid and filtered through a Gooch, the precipitate washed with 2% H_2SO_4, dried, heated to a dull red heat, cooled and weighed. H. G.

1253. Lubricating Properties of Greases from Petroleum Oils. F. H. Rhodes and H. D. Allen. *Ind. Eng. Chem.*, 1933, **25**, 1275–1280.—In lubrication by soda-base greases, the soap plays an important part in the formation of the lubricating film. The greases were prepared by dissolving fat in petroleum oil, and then heating the mixture with strong caustic soda solution until the fat had saponified and almost all the water was driven off. These fats contain mixtures of sodium soaps of various fatty acids in varying proportions. The presence of sodium oleate in solution in the oil decreases the coefficient of static friction. The glycerol stabilises the grease, minimises the change in consistency in heating or in use. It also increases the lubricating power and eliminates the increase in the coefficient of static friction. W. S. E. C.

1254. Viscosity of Tars. G. Barr. *Roads and Road Constr.*, 1933, **11**, 221.—This paper refers to B.S.I. Specification No. 76 for Tars Nos. 1 and 2, in which the Hutchinson Tester is specified for No. 2 Tars, and the B.R.T.A. Consistometer for No. 1 Tars. The results obtained with these instruments by Pickard and by Barr and Thorogood are compared, and the work carried out by Schläffer and Rodel (*Schweizerischen Zeitschrift fur Strassenwesen*, 1932, **7–9**, 6) is discussed.

The latter investigators obtained data for 8 tars with each instrument at 25° C., 30° C. and 50° C., and compared Hutchinson times at 25° C. with B.R.T.A. times at 30° C. for 38 tars and mixtures. From the results obtained they conclude that, at any one temperature common to both tests the B.R.T.A. time is always the longer. The log time–log temperature curves for a given tar in two instruments are rarely parallel.

The temperature of 30° C. for B.R.T.A. tests gives as close a reproduction as is possible of the Hutchinson times at 25° C. Hutchinson times above 25 seconds tend to be longer than B.R.T.A. times, but there may be differences of 10 seconds or more in either direction near 100 seconds.

The general conclusions from the correlation of the results obtained by various investigators are that the concordance between the various equations for converting Hutchinson times to B.R.T.A. times at the same temperature is more satisfactory than might be expected, but the agreement between the factors for conversion to absolute viscosity is not so good. It appears from Pickard's results that none of his materials exhibited thermal hysteresis, while Barr and Thorogood found such evidence for the existence of structural viscosity that they were only able to use the results obtained with three tars. Some tars, at least, appear to be thixotropic, and if the period of cooling from high temperature is short, or if the material is worked vigorously enough before or during measurement of viscosity, a reproducible value should be obtained. It is presumed that in these circumstances (and in general for normal liquids) Pickard's conversion factors are the more accurate.
A. O.

1255. Viscosity-Temperature Relationships of Tars. W. Eymann. *Asphalt u. Teer*, 1933, **33**, 751–754.—If the viscosities of tars, measured in the road-tar consistometer are plotted against temperature on double logarithmic paper, straight line relationships are obtained. From this fact is deduced the law that the temperature changes in inverse proportion to a power of the corresponding viscosity or $t = \frac{a}{v^m}$ where t is the temperature, v, the viscosity, and a and m constants characteristic of the tar. The evaluation of a and m is discussed.

The relative values of the times of outflow of tars for jet sizes of 4, 5 and 10 mm. is calculated from the times for water with these jets—namely, 3·2, 2·3 and 0·7 secs.

Tables are given showing the values of "a" and "m" for several classes of tars. Tars are also characterised by the temperature at which their fluidity is equal to that of water and data are given for several products.
E. B. E.

1256. Patents on Analysis and Testing. J. G. A. Rhodin. E.P. 399,802, 11.10.33.—Apparatus for measuring the viscosity of liquids and gases. It comprises a sliding rod immersed in a channel through which the fluid under test is caused to flow and capable of movement in the direction of fluid flow against the action of a spring. Means are provided for controlling the flow of fluid under test, and for the surface area of the moving body to decrease with increase in viscosity of the fluid.
W. H. T.

Class 600. Refining and Refineries.

1257. Petroleum Refineries, including Cracking Plants in the U.S. January 1, 1933. G. R. Hopkins and E. W. Cochrane. *U.S. B. of Mines. Information Circular* 6728, Jan., 1933.—The number of completed refineries in the U.S. on January 1st, 1933, is given as 505, an increase of 32 over the 1932 figure, 18 refineries being also under construction; 26 of the completed refineries were shut down. About half of the new plants were in the East Texas area, there being comparatively little construction outside the Mid-Continent area. Total daily capacity of all refineries is given as 3,921,055 brl., a decrease of 3% on the previous year, due to the cumulative effect of decreased runs of crude to stills, beginning in 1930, plus the continued gain in the yield of gasoline by cracking. The number of refineries with cracking equipment increased from 207 in 1932 to 212 in 1933, although the total daily capacity of the cracking plants was 1,997,745 brl., a slight

decrease over last year. The total daily capacity of the vapour phase cracking plants was at least 75,000 brl., an important increase over 1932. Full details are given of the operating company, location, capacity and type of distillation or cracking unit in each state, with a recapitulation of the number of refineries by states and of the number and type of cracking plants in operation. C. L. G.

1258. Using Hygroscopic Salts in the Refineries of Continental Europe. R. Sunder. *Petr. Eng.*, Oct., 1933, **5** (1), 26.—Hygroscopic salts are used for the drying of crude oil in refineries in Bohemia, Galicia, Alsace, etc.

Calcium and magnesium chlorides are the salts generally used, the choice depending on freight and import duty rates, etc. The salts are used in the fused form in blocks of 8–10 cwt. both for desiccation and the preparation of freezing mixtures for wax removal. To obtain the same cooling effect as with magnesium chloride, it is necessary to use twice as much calcium chloride. Thus 10% and 20% solutions of $CaCl_2$ freeze at 21° F. and 12° F. respectively, and similar solutions of $MgCl_2$ at 12° F. and –17° F. Choking of pumps is avoided by preparing first a strongly concentrated solution of the brine and rejecting any residues, the solution being diluted as required. Both salts have similar properties as regards corrosion of iron. In practice it is necessary to maintain a denser brine than calculated to compensate for losses. In general the freezing point of the brine should be about 5° below the cooling point absolutely necessary. Analyses of the calcium and magnesium chlorides usually used are reproduced. C. L. G.

1259. Application of Tube Stills to Petroleum Refining. C. M. Johnson. *Refiner*, 1933, **12**, 383–387.—A description in general terms of the trend in design and use of tube stills in the petroleum industry. The earlier designs operated with low furnace temperatures and large volumes of furnace gas to prevent overheating the walls and the oil, resulting in low thermal efficiency. Improvement has been effected by a reduction of excess air, furnace volumes usually being large to allow of complete combustion of the fuel and to prevent flame impingement on the tubes. The recirculating furnace is the most suitable type for heating by convection when low furnace temperatures are necessary and when the difference between the initial and final gas temperature is small. In furnaces incorporating a radiant section, the radiant heat may be supplied as "shielded" radiant in which the source of the radiation is a small incandescent within which the combustion of the fuel is effected, or as "open" radiant heat without the interposition of any form of shield or screen between the source of heat and the absorbing surface. The latter form is preferabie for application to the refining of oils. B. C. A.

1260. Theoretical Comparison of Petroleum Distillation Systems. P. Meyer. *J. Inst. Petr. Techn.*, 1933, **19**, 819–834.—The distillation systems, flash vaporisation, continuous column distillation and batch distillation are compared with the aid of mathematical concepts and published experimental results. The feasibility of comparing their relative efficiencies by means of an "overlap coefficient" is discussed. G. R. N.

1261. Heat Flow Diagram of Cracking Still. G. Vandenberg. *Refiner*, 1933, **12**, 380–382.—A heat flow diagram is given for a cracking still having an assumed throughput of 2000 brl. per day and the heat balance is shown for each stage of the operation. Also in tabular form heat balances for the furnace, drum, separator, heat exchangers, fractionator, partial condenser exchangers, accumulator, together with an overall balance are given. It is pointed out that the radiation loss and the quantity of heat stored in the

circulating stock are larger than are commonly supposed. Hot tar carries off much of the supplied heat, rendering the provision of efficient heat exchange desirable for this product. B. C. A.

1262. Coal Bitumen and the Conversion of Coal into Pseudobitumen by Hydrogenation. F. Fischer, K. Peters and W. Cremer. *Fuel*, 1933, **12**, 390.—The bitumens extracted from coal by solvent-action may be resolved into "oily" and "solid" fractions by the use of kieselguhr followed by petroleum ether, or ethyl ether, or alternatively by distillation.

It was found that all the coals investigated, with the exception of the Sophia-Jacoba anthracite, can be converted into bituminous substances by the action of hydrogen under high pressure and elevated temperatures without decomposition occurring. The products resembled normal bitumens obtained by extraction, and for this reason were termed "pseudobitumens." Hydrogenation of coal to pseudobitumen proceeds at 200° C., but is much more rapid at 285° C. The pseudobitumens obtained, whose formation is due to a depolymerisation of the coal under the influence of hydrogen, consist, like natural bitumen, of various fractions with characteristic colours. It is possible to replace the caking properties lost by a coal owing to the removal of natural bitumen by the artificial formation of pseudobitumen. Similarly, a lean coal may have coking properties imparted to it by the same treatment. The depolymerisation of bituminous coal by hydrogenation renders possible a stage by stage, progressive degradation of the lean coal to the final state of oily bitumen. E. N. H.

1263. Vapour Recovery Plant at Muskogee. Anon. *Refiner*, 1933, **12**, 390–391.—Describes the installation and operation of a new absorption and distillation plant of Alco design and erection for the handling of 5,500,000 cu. ft. mixed vapours per day at the Muskogee refinery of the Pure Oil Co. Mixed refinery gases, including those from Gyro vapour phase units, are compressed by means of three twin 200 h.p. Bessemer gas-engine driven compressors and then uniting with the gases from the Cross units enter the absorber. The gas from the top of the absorber leaves as plant fuel. The fat oil is stripped by means of high and low pressure stills, and the product fractionated to a propane-free gasoline I.B.P. 80° F. and F.B.P. 306° F. B. C. A.

1264. Hypochlorite Process for Treating Natural Gasoline. K. S. Ritchie. *Petr. Eng.*, Sept., 1933, **4** (8), 28.—The chemistry of the process is outlined and a description given of the plant under discussion, which is used for treating a natural gasoline containing high percentages of H_2S and of mercaptans. The advisability of using dilute caustic solution for the removal of mercaptans, as explained by Birch, is shown by the fact that in this plant 37% less chlorine was used in removing the remainder of mercaptans and other organic sulphur compounds left over after the caustic treatment, when the strength of the soda solution was reduced from 20° Bé to 7° Bé.

It was noticed, however, that during a long spell of cold weather the consumption of chlorine was reduced by about 25% without any change in operating method having taken place. Accurate records were kept and a chart is presented to cover a year's operation showing chemical consumption, max. and min. air temperatures, tower temperatures and gravity of treated gasoline. The chart clearly shows that increase in temperature results in increased usage of chlorine. The writer's explanation of this phenomenon is that the solubility of mercaptans in water decreases with increase in temperature, as is the case with H_2S. Consequently the equilibrium point

of the reversible reaction $RHS + NaOH \rightleftharpoons RSNa + H_2O$ is changed, and with rising temperature there is an increase in the mercaptan content of the caustic washed gasoline. If this is so, then the constant partition coefficient, relating the solubilities of mercaptans in oil and water in the above reaction, has a definite value for each temperature.

To test these theories a special high temperature test was made, solution temperatures being raised by cutting off the final cooler in the stabilizer and allowing the gasoline to enter the treating plant uncooled. The temperature of the incoming gasoline was 25° F. higher, and the treating solution temperatures soon reached an equilibrium point 20° F. higher than previously. Shortly afterwards the charges of hypochlorite had to be gradually increased, and after four days' operation consumption had risen by 68%. The experiment was then stopped by passing the gasoline through the cooler again, and as treating solution temperatures decreased, so chlorine consumption dropped, until finally both returned to normal. Since all other conditions were practically unchanged, the experiments showed that temperature does have a strong influence on the solubility of mercaptans in dilute aqueous solutions. The ordinary daily plant readings plotted to show chlorine consumption against temperature of No. 1 hypochlorite tower show a similar trend. The results show that where large volumes of chlorine are used, a substantial saving in chemicals can be effected by designing plant to operate at treating solution temperatures near an optimum of 50° F. A cooling system utilising reflux liquids from high pressure stabilizers as refrigerant is suggested.

Time is also an important factor in obtaining the greatest solubility of mercaptans in the aqueous caustic solutions, but this factor is limited by economic considerations. Counter current flow of caustic solution and gasoline is suggested as a possibility. R. A. E.

1965. Continuous Vacuum Filters in Contact Treating. L. C. Trescott. *Refiner*, 1933, **12**, 396–400.—Whilst in the small contact filter plant where the quantities of oil and clay are not large and where the stock may vary, pressure filters and batch operation are most suitable, where continuous operation is possible, vacuum filters show definite advantages. These advantages are continuous operation, low labour cost, high throughput of oil per square foot of filter area, and a reduced oil content of the clay cake.

This type of filter is unsuitable for the filtration of stocks in naphtha solution, but may be used on heavy stocks without dilution up to a viscosity of 100 Saybolt at 210° F. with excellent results.

Comparative costs are cited for vacuum *v.* pressure filtration, on plants of capacity of 1000 brl. per 24 hrs., operating on a coastal red oil of 75 sec. Saybolt at 210° F., requiring a treatment of 4% by weight of clay. The cost per brl. at a production of 100 50-gal. barrels per day amounts to $0.0245 per brl. for vacuum filtration and to $0.05037 in the case of pressure filtration.

The principal cause of the difference lies in a markedly decreased labour cost, and in addition there is an appreciable increase in oil yield from the vacuum filter, due to the thin cake produced, measuring $\frac{1}{4}$ to $\frac{1}{2}$ in. thickness, as compared with $\frac{1}{2}$ to 1 in. for the pressure filter. The thinner cake thereby produced is much drier, and with an oil of the type cited the oil content of the cake will amount to 20 or 25%, instead of to 40% or higher in the case of the pressure cake.

Unless the clay is of such a nature as to produce a brittle easily cracked cake, allowing sufficient air to be drawn through the cracks to cause a deterioration in colour, no trouble by oxidation of the oil is noticeable, and in addition the odour of the oil from a vacuum is much better than

from a pressure filter, all gaseous and odorous products being carried off and exhausted through the vacuum pump.

To avoid condensation of moisture, which would be picked up by the clay and would lead to a plugged cloth, no cover should be used on the filter drum. Tight filter cakes are usually caused either by adsorption of moisture or are a function of the clay. Special care should be taken that all moisture is driven off before the mixture reaches the filter, and the operating temperature of the filter should be kept high. The high filtration temperature necessitates the use of a monel cloth, of a flat weave permitting the scraper to take the cake clean from the cloth. The filtration drum should be washed once a shift by rotation in the tank without suction. In starting up filtration the hot oil-clay mixture is circulated through the tank until the system reaches filtration temperature before suction is applied, otherwise the cloth is likely to plug and low filtration rate exist from the start.

By reason of the necessary complications in process, it is doubtful whether any advantage would be derived from use of vacuum filters in the filtration of heavy stocks in naphtha solution. B. C. A.

1266. Water Determination in Raw Clays. E. W. Zublin. *Nat. Petr. News*, **25** (37), 36.—It is often undesirable to determine the moisture content of a refinery clay by heating a sample to constant weight at 100° C. The following method has been suggested as a control method.

A hot plate is covered with a layer of sand ½ in. thick. A copper tray embedded in this sand is filled with oil maintained at 475° F.–500° F. 25 grm. of finely crushed clay are weighed out into a viscosity pan and placed in the oil bath for 20 minutes. The contents of the pan are shaken every 2 minutes. The difference in weight after cooling is calculated as moisture. H. G.

1267. Duo-Sol Lube Extraction Process. M. B. Miller. *Nat. Petr. News*, **25** (41), 26–28.—In this process for refining lubricating oil distillates, separate solvents are used for the extraction of naphthenic and paraffinic components. The solvents used are, respectively, a special blend of coal tar acids and bases with a boiling range of 360° F.–405° F. and propane. The solvents run counter current through the system, the charging stock being fed in at the centre. In addition to the usual claims of improvement in viscosity index and viscosity-gravity constant, it is stated that the present process eliminates the need for subsequent acid treatment of the extracts, simple clay contacting being sufficient to finish the oils. H. G.

1268. High Pressure Stabiliser Raises Yield. Anon. *Petr. World* (*L. A.*), 1933, **30** (9), 258.—A description of the stabilising unit of Wiltshire Oil Co. is given, which has a capacity of 30,000 gallons per day of propane-free product. The vapour pressure of the stabilised gasoline is 25 lb. by the Reid Test, whilst the reject is practically free of normal butane. Worthington high volatility pumps are incorporated. Vapour from the absorption plant is compressed to 260 lb. and 85% is condensed in the cooling tower. Mixed gasoline and condensed vapours pass through the exchangers to the column at a temperature of 220° F. A Foxboro' stability control maintains the rate of feed constant. Fixed gas is rejected to the dry gas line at the rate of 100,000 cu. ft. per day. Column pressure is kept steady by a Fisher pilot control back pressure regulator working at 210 lb. The stabiliser column has a maintained reflux ratio of 2½ to 1 with the column top temperature at 110° F. Vapour from the column is condensed through a 950 sq. ft. condenser, quantity of which is controlled by a Fisher remote control gradual flow liquid lever controller working on the water line to the condenser. The

new stabiliser has increased the yield to 2·3 gal. of 93-4% propane-free gasoline per 1000 cu. ft. of wet gas, which represents an increase of 21%. 75% of this dry gas was returned to the wells at 400 lb. pressure. This has recently been reduced to 50% with a resultant increase in yield to 2·6 gal. of stabilised gasoline per 1000 cu. ft. of gas. R. E. D.

1269. Gasoline Plant Operating under Well Pressure. Anon. *Refiner*, 1933, **12**, 392–393.—Describes the construction and operation of a Braun unit processing gas under 250 lb. pressure. It consists of three high pressure absorbers, each having a capacity of 30,000,000 cu. ft. of gas. The gasoline content averages 0·30 gal. per 1000 cu. ft. and oil circulation is at the rate of 7 gal. per 1000 cu. ft. B. C. A.

1270. Distillation Unit Increases Yield of Lubricating Oil. P. Truesdell. *Chem. Met. Eng.*, 1933, **40**, 517–519.—While a number of oil companies have been developing solvent extraction for the refining of lubricating oils, at least one company has been studying more closely the physical and chemical laws which govern heat-transfer, distillation and fractionation. The results of these studies are embodied in a distillation unit recently installed by the Bradford Oil Refining Co. The unit was designed with the object in view of manufacturing lubricating oil with a very low carbon content and a very high flash point. The unit consists primarily of a pipe still and a flash fractionating tower with the usual auxiliary equipment. The pipe still furnace tubes are smaller than usual, and are so arranged that they receive the full effect of the direct radiation from the combustion gases as well as from the incandescent walls and floor of the furnace. The areas of the heating surfaces and the velocity of the oil through the tubes is such as to permit the input of the necessary heat into the oil under mild conditions and at moderate temperatures. The velocity of the oil is unusually high, so the stagnant oil film on the wall of each tube is very thin and practically no decomposition occurs. The tower consists of a bubble tray column and flash chamber. In the base of the latter is the stripping section, consisting of seven bubble trays. Open steam is introduced at this point. The bubble tray column contains bubble trays and caps which are so designed to produce a foam of liquid and vapour on each tray. Above the topmost bubble tray is a layer of vitreous tile. The tower is so designed and the flow of oil is so timed that oil and vapours are held in the system for only about 15 mins. The throughput of this unit is 1500 brl. crude per day flashing at 670° F. to give 20% bottoms or steam refined stock. The 80% is sharply fractionated into gasoline overhead and side streams of naphtha, kerosine, fuel oil, light wax distillate and heavy wax distillate. G. R. N.

1271. Continuous Acid Treatment Lubricating Oil Plant. M. Grisard. *Refiner*, 1933, **12**, 388.—Describes the installation and operation of a De Laval S-N continuous acid refining unit for lubricating oils, in the refinery of the Belgian Lubricating Products Co., Mons, Belgium, including two De Laval separators, each treating 10 to 20 tons of oil having a viscosity of 18° Engler at 50° C. per eight hours. With less viscous oils the capacity is somewhat higher. B. C. A.

1272. Electrical Treatment of Lubricating Oils. Anon. *Petr. Z.*, 11.10.33, **29** (40); *Motorenbetrieb*, **6** (10), 3–4.—This article deals with the production of lubricating oils by the "Elektron" process in which oils are subjected to an electrical discharge under very high tension. The lubricating oils so produced are claimed to be superior in quality, giving a higher compression in the engine, a very small carbon residue, a low consumption and no oxidation products. W. S. E. C.

1273. Reduction of Fire and Explosion Hazards. I. B. Funk. *Petr. World* (*L.A.*), 1933, **30** (9), 40–41.—Operating hazards on modern plant may be summed up as follows: (1) Escaping vapours and liquids from leaks in vessels, valves and fittings; (2) Absence of proper marking of valves, lines, etc.; (3) Electric system not properly insulated and grounded; (4) Lack of sufficient oil in switches; (5) Water spray from cooling tower blowing over electrical equipment.

Unsafe practice may be classified as: (1) Lack of proper supervision; (2) Operator's lack of familiarity with plant; (3) Failure to follow instructions; (4) Smoking in or around plant; (5) Rubbish and inflammable material near plant; (6) Iron-shod footwear; (7) Failure to replace vapour proof globes after changing lamps; (8) Failure to turn off current when changing lamps; (9) Use of flash lights which are not vapour proof; (10) Operator going off shift without telling oncoming operator plant conditions; (11) Failure of operator to note unusual conditions on operating report; (12) Failure of operator to report leaks or unsatisfactory operation of any equipment at once; (13) Filling pressure storage tanks above top of top gauge glass connection. R. E. D.

1274. Accident Prevention Programme for Refinery Operation. W. P. Reymond, Jr. *Refiner*, 1933, **12**, 402–405.—Efficiency and safety go hand in hand, and whilst accident prevention work is essentially humanitarian, it invariably leads to increased efficiency. Success in accident prevention is dependent upon the full co-operation of all grades. While it is essential that refinery equipment be designed, safeguarded, maintained, and inspected with a view to accident prevention, equal importance attaches to the performance of all duties in accordance with safe practices. For the accomplishment of these purposes organised co-operation and propaganda are necessary.

It is necessary that the management should extend active support in accident prevention work and be prepared to deal firmly with non-co-operation. The organisation for the promotion of safety should be the care of a particular individual, who in the case of a large refinery may devote his whole time to the task. Under the supervision of this safety director, there operates the safety organisation, which may comprise the following activities: general safety committee, workman's safety committee, foremen's inspections, investigation of accidents, formation, adoption and enforcement of safety rules, and an educational programme.

The general safety committee may comprise foremen representatives from all refinery departments and the personnel of the committee should be changed say, at six monthly intervals. Regular and frequent meetings of this committee should be held with the safety director as chairman, and all matters of safety ensurance should come within its reference. In turn the workmen's committee constituted and operating similarly to the preceding will enable the workmen to take an active part in the accident prevention programme. Weekly inspection by representatives of the general safety committee with a view to discovering unsafe conditions or practices in the refinery should be carried out and report made thereon.

All accidents should be the subject of investigation and report by the departmental foreman involved and by the foreman responsible for safety inspection at the time. Their reports should be reviewed by the safety director. This investigation should be carried out even in minor cases not involving personal injury, so that necessary preventive measures may be adopted.

1. Instruction outlining the methods to adopt for the performance of everyday duties.
2. Instructions outlining the procedure for conducting refining operations.

3. Instructions defining the procedure for preparing equipment for inspection, maintenance and repair.
4. A system of written permits for issue by authorised persons for work on or near equipment that has been in service.
5. Instructions for the personal conduct of employees and the use of safeguards.

Safety instructions should be fully complied with and infringement followed by disciplinary action. In order to impress on all operatives the necessity for and the benefits to be derived from safety measures a continual educational programme must be maintained, designed to inculcate into the minds of all employees a constant feeling of safety consciousness. B. C. A.

1275. Relieving Pumps of Vapour-Lock. Anon. *Refiner*, 1933, **12**, 410.—Describes a device attached to the pumps of a gasoline plant in Southern California, handling raw natural gasoline. Suction is taken from a vertical tank, having sufficient head to maintain a slight pressure on the suction of the pump. The discharge line to the fractionator is fitted with a by-pass to the supply tank, which is kept closed in normal operation. On the occurrence of vapour lock, this by-pass is opened manually just so long as to permit of suction recovery, which normally requires only a few seconds. Back-fire or the return of gasoline from the fractionator is avoided by a swing check valve in the discharge line to the fractionator. B. C. A.

1276. Effect of Pressure on the Attack of Steels by Hydrogen Sulphide. E. Dittrich. *Fuel*, 1933, **12**, 383.—A series of commercial steels was tested as to resistance to corrosion on heating up to 500° C. on hydrogen sulphide-hydrogen mixtures at pressures from 1 to 75 atm., of which 0·8 to 12 atm. corresponded to the hydrogen sulphide. Previous investigations at atmospheric pressure indicated that the stability of steels depends in the first place on chromium content, and the author found that, while the highly alloyed steels (containing more than 13% chromium) are fairly insensitive towards changes in pressure and concentration, the other steels (containing less than 13% chromium) show an increase in corrosion with increasing pressure or with increased concentration of hydrogen sulphide. Low alloyed steels (containing less than 6 per cent. chromium) on pressure treatment in definite temperature ranges are more strongly attacked than unalloyed steels which, at normal pressure, show considerably greater corrosion. With all steels the attack increases greatly with temperature, but it was found that corrosion commences at a temperature which increases with the increase in chromium content of the steel. Nickel lowers this temperature, molydenum raises it. With increasing temperature the ratios of the corrosion values of non- or low-alloyed steels to those of high-alloy steels become smaller (*e.g.*, at 400° C. his ratio is 12 : 1 and at 500° C. 9 : 1), so that from the viewpoint of economy, high-alloy steels offer no special advantage for many purposes. E. N. H.

1277. Patents on Cracking. A. D. Smith. U.S.P. 1,928,985, 3.10.33.—A combined liquid and vapour-phase cracking process.

C. W. Watson. U.S.P. 1,929,529, 10.10.33. Heavy cracking stock is heated under pressure and vaporised in two stages, one at high and the other at low pressure. The combined vapours are then passed to a conversion zone.

J. Delattre-Seguy. U.S.P. 1,929,795, 10.10.33. The products of cracking issuing from a conversion zone are passed to a second zone containing reflux condensate, where more intense conditions of temperature and pressure prevail. The resultant vapours are fractionated and the reflux returned to the second zone.

J. G. Alther. U.S.P. 1,930,221, 10.10.33. Oil from a cracking zone is vaporised and the residue subjected to reduced pressure for the removal of light products. After settling out solid material, the residue is returned to the cracking zone.

G. Egloff. U.S.P. 1,930,231, 10.10.33. Products from a cracking still are fractionated and the reflux subjected to more intense cracking conditions in a pipe still before being returned to the shell still.

W. F. Sims and V. U. Cloer. U.S.P. 1,930,372, 10.10.33. A cracking still and a preheating still combined in one structural unit with means for heating each still separately.

W. M. Stratford. U.S.P. 1,930,730, 17.10.33. Liquid-phase cracking with means for vaporising the cracked residue to yield a clean recycle stock.

G. Egloff. U.S.P. 1,931,757, 24.10.33. Heavy oil is cracked, the reflux condensate recycled, and the gasoline vapours re-cracked in the vapour-phase before final condensation.

S. P. Coleman. U.S.P. 1,933,048, 31.10.33. Cracking of oil by direct contact of hot, non-oxidising gases in admixture with steam.

E. P. Peck. U.S.P. 1,933,507, 31.10.33. High temperature cracking with the addition of an intermediary stock such as kerosine to reduce the pressure of the reaction. W. H. T.

1278. Patents on Coal. Standard Oil Development Co. E.P. 400,009, 19.10.33.—Surface disintegration of solid carbonaceous fuels (coal, coke, etc.) is inhibited by spraying with a solution of a petroleum sulphonic acid compound, a partially neutralised sulphonic acid or an alkali sulphonate. W. H. T.

1279. Patents on Hydrogenation. H. I. Waterman. U.S.P. 1,929,528, 10.10.33.—Hydrogenation of carbonaceous materials in the presence of a catalyst containing molybdenum and an activated mass derived from an alkaline iron oxide-containing mass obtained from the conversion of bauxite to aluminium oxide by the wet treatment.

C. Krauch. U.S.P. 1,931,549 and 1,931,550, 24.10.33. Hydrogenation of liquid and solid fuels in the presence of an inorganic nitrogen compound as catalyst. The second patent specifies the use of a solid inorganic nitride as catalyst.

W. Gaus. U.S.P. 1,932,174, 24.10.33. Heavy sulphurous hydrocarbons are subjected to hydrogenation in the presence of metallic sulphides and difficultly reducible oxides, for just sufficient time to remove sulphur in the form of hydrogen sulphide. The purified oil is then subjected to cracking.

M. Pier. U.S.P. 1,932,186, 24.10.33. As above, but omitting the final cracking operation.

F. W. Guthke. U.S.P. 1,932,369, 24.10.33. Desulphurising by hydrogenation in the presence of metallic sulphides from groups 6–8 of the periodic system. The conditions employed are such as to preclude cracking, polymerisation or hydrogenation of the hydrocarbons under treatment.

M. Pier. U.S.P. 1,932,673, 31.10.33. Hydrogenation of liquid bituminous material in the presence of a catalyst which is dispersed in the bitumen as a colloid. The specific gravity of the bitumen is made equal to that of the catalyst by the addition to the latter of a substance of suitable specific gravity.

E. M. Clark. U.S.P. 1,933,047, 31.10.33. Production of lubricating oils of increased viscosity index from lower grade petroleum by hydrogenation at 700°–850° F. and at above 25 atm. in the presence of sulphur insensitive catalysts. The reaction is stopped when 20% of naphtha has been formed.

M. Pier and K. Winkler. U.S.P. 1,933,069, 31.10.33. Recovery of hydrogen present in the gases resulting from destructive hydrogenation.

The gases are washed with high boiling hydrocarbon oil for the removal of normally condensable material, and then cooled in order to effect separation of hydrogen from the gaseous hydrocarbons and sulphur compounds.

E. J. Gohr. U.S.P. 1,933,107, 31.10.33. A two stage hydrogenation process for the production of kerosine from petroleum in the first stage and motor spirit in the second. Operating conditions for each stage are quoted.

W. L. Gomory. U.S.P. 1,933,108, 31.10.33. Hydrogenation of petroleum, followed by fractionation of the products. Reflux condensate is withdrawn, light fractions removed and the residue returned to the conversion zone.

J. M. Jennings. U.S.P. 1,933,503, 31.10.33. Destructive hydrogenation of hydrocarbon oil in which the products of reaction are maintained in contact with a packed mass of catalyst until their temperature has dropped below that of decomposition.

E. B. Peck. U.S.P. 1,933,508, 31.10.33. Hydrogenation of heavy hydrocarbons containing tarry bituminous substances. A "sulfactive" catalyst is used which comprises oxides and sulphides of metals of the second and sixth groups of the periodic system. A portion of the catalyst is removed from time to time and washed with a solvent for the removal of tarry material of high molecular weight. W. H. T.

1280. Patents on Gas. Soc. Rech. et d'Exp. Petr. E.P. 398,010.—A vapour recovery process of high thermal efficiency in which the gas is passed over layers of adsorbent material of high capacity. When the latter is saturated, the adsorbed constituent is steamed out in the reverse direction and the adsorbent is then air-dried and cooled in the opposite direction.

C. A. Rosier. E.P. 398,037, 7.9.33. A method of gasifying hydrocarbon oils and mixing with air or steam to give a mixture suitable for power or heating purposes. The apparatus used consists of an electrically heated cylindrical chamber divided by a central tubular baffle into two annular compartments. In these, the oil is vaporised and the air or steam preheated. The baffle is constructed of material having catalytic properties. S. B.

Bat. Petr. Mij. E.P. 400,054, 19.10.33. Acetylene is removed from gases by counter-current absorption in one or more solvents of the class consisting of polyglycols, their ethers, esters and mixed ester-ethers. W. H. T.

1281. Patents on Motor Fuels. L. B. Kimball. E.P. 399,198, 29.9.33.—A method of adding an anti-detonating liquid to the fuel supply line of an I.C. engine. The liquid is forced into the intake under a pressure exerted by the exhaust gases of the engine, the flow being controlled by the throttle mechanism.

Gulf Refining Co. E.P. 399,733, 12.10.33. An inhibitor of gum formation in motor fuels which consists of peri-monoxynaphthalene or its equivalent reduction product of 1·8 dioxynaphthalene. The amount to be added may vary between 0·005 to 0·01%.

A. Try and M. Stuart. E.P. 400,234, 23.10.33. Distillates obtained from mixtures of oil with coal, lignite, etc., are converted into products of lower boiling point by treatment in the vapour phase with a silent electrical discharge.

W. W. Gary. U.S.P. 1,929,489, 10.10.33. Petroleum is treated with dry, gaseous sulphuric anhydride and the reaction products separated. The treated material is then contacted with an agent capable of coagulating the remaining reaction products.

J. B. Weaver. U.S.P. 1,929,861, 10.10.33. Gum and colour forming bodies in cracked gasoline are removed by mixing the latter with a fine acid-treated clay, the mixture then being passed in the liquid phase upwardly through a vertical treating zone where it is heated and agitated. The low boiling

constituents are removed as vapour and condensed, the balance of the mixture being redistilled in order to separate the reagent and undesirable high boiling components.

H. Thomas. U.S.P. 1,929,907, 10.10.33. A clay tower for refining cracked gasoline in which provision is made for supporting the refining material while permitting free egress of vapour and liquid.

H. C. Weber. U.S.P. 1,930,216, 10.10.33. Desulphurising distillates by the simultaneous action of substances capable of producing hydroxyl ions and chlorine ions while in the presence of metallic silver and metal electropositive to hydrogen.

J. C. Morrell. U.S.P. 1,930,249, 10.10.33. A method of obtaining a refining agent from the sludge produced by treatment of distillates in the vapour phase with sulphuric acid containing a spacing agent. The sludge is separated into an oily and an aqueous layer containing a substantial portion of the spacing agent. Fresh sulphuric acid is added to the aqueous layer.

J. W. Brown. U.S.P. 1,930,453, 10.10.33. Cracked distillate is fractionated and the vapours treated with clay and then re-fractionated in a second column. The heavy product from the latter is mixed with the polymers from the clay treatment and the mixture introduced at selected points in the first fractionation stage.

F. W. Hall and J. H. Grahame. U.S.P. 1,930,974, 17.10.33. Treatment of cracked distillate with adsorbent catalyst in the vapour phase followed by fractionation of the vapours. The polymer from the adsorbent is mixed with the distillation residue to form a stock for reboiling, the vapour from this stock being injected into the column together with the incoming contacted vapour. W. H. T.

1282. Patents on Kerosine. S. N. Sherwood. E.P. 399,906, 19.10.33.—An arrangement is described which permits of the frictional detachable attachment of a flat wick lamp burner to the reservoir of a lamp. Spring tongues with projections at their ends are formed on the lower shank of the burner to engage with the tubular receiver.

F. C. White. E.P. 400,359, 26.10.33. Apparatus for vaporising paraffin oil for diffusion in gas contained in gas mains. It consists of an upright heated flue pipe surrounded by a helical radial band, the latter being surrounded by a closely fitting outer casing. The gas is thus constrained to ascend along the heated radial band in counter-flow to the paraffin oil. W. H. T.

1283. Patents on Lubricants and Wax. Edeleanu Ges. E.P. 399,030, 28.9.33. —Lubricating oils of high viscosity index are manufactured from a suitable base by extraction with liquid sulphur dioxide at a temperature above 25° C.

R. C. O. Hickman. E.P. 398,936, 28.9.33. A lubricant is described which consists of a cellulose ether dissolved in castor oil and a heavy mineral lubricating oil (25–50%).

Edeleanu Ges. E.P. 398,992, 28.9.33. Purification of highly viscous mineral lubricating oil in a counter-current mixer by means of liquid sulphur dioxide. Before reaching the mixer, a large proportion of the sulphur dioxide is mixed with the oil without effecting any separation into extract and raffinate.

R. E. Manley. U.S.P. 1,929,821, 10.10.33. Dewaxing of lubricating oil by mixing the latter with an inert solid filter-aid recovered from a previous dewaxing operation, chilling the mixture and separating the wax and filter-aid together.

A. G. Peterkin and L. B. Smith. U.S.P. 1,929,933 and 1,929,934, 10.10.33. Processes of dewaxing or sweating in which use is made of solutions of alkaline silicates for separating oil from wax. Such solutions lower the surface tension between oil and wax and facilitate separation of the latter from chilled mixtures.

C. E. Fox. U.S.P. 1,930,006, 10.10.33. Removal of fine foreign particles from used lubricating oil by washing with hot water without agitation sufficient to form an emulsion.

M. Mueller-Cunradi and R. Werner. U.S.P. 1,930,468, 17.10.33. Refining of paraffin wax by hydrogenation at 250°–400° C. and at least 20 atm. in the presence of a mixed catalyst which comprises two elements (bismuth or vanadium and iron).

L. D. Jones. U.S.P. 1,930,479, 17.10.33. Dewaxing oil-wax mixtures by mixture with dichlorethane, chilling and then separating the wax by centrifugal means.

F. Hofmann and C. Wulff. U.S.P. 1,933,434, 31.10.33. Production of viscous oil by the condensation of unsaturated cyclic hydrocarbons together with gaseous olefines. The reaction is carried out at temperatures up to 300° C. in the presence of hydrogen halide and of a halide of boron.

W. H. T.

1284. Patents on Asphalts and Fluxes. R. H. King and others. E.P. 399,176, 25.9.33.—A road surfacing material is obtained by heating a mixture of a crushed lava (¼ in. to 200 mesh) and 15% of bitumen. The lava is obtained by heating earth to a temperature sufficiently high to melt it and allowing to cool to a porous honeycomb structure.

F. B. Dehn. E.P. 400,409, 26.10.33. Stabilised emulsions of asphalt are formed by adding molten asphalt to a hot caustic alkaline 1% solution (40–50%). Saponifiable material (less than 1%) is introduced after a portion of the asphalt has been added, and the remainder of the asphalt is then added together with less than 2% of colloidal clay (bentonite).

H. F. Angstadt. U.S.P. 1,931,880, 24.10.33. Production of valuable products from impure soap-containing asphaltic residue obtained from the distillation of lubricating oils. Water is added to the residue and the mixture heated under sufficient pressure to prevent boiling. Purified asphalt and impurities are separated, the latter containing soaps capable of yielding water-insoluble organic acids.

W. H. T.

1285. Patents on Fuel Oil. J. Y. Johnson. E.P. 399,150, 26.9.33.—A process for improving Diesel fuels by the addition of highly unsaturated aliphatic hydrocarbons (up to 20%) containing more than two carbon atoms such as diacetylene or the liquid condensate obtained by cooling to below 40°, a gas containing acetylene issuing from the treatment of hydrocarbon gases in the electric arc.

W. H. T.

1286. Patents on Special Products. J. Y. Johnson. E.P. 398,982, 28.9.33.—Manufacture of unsaturated alcohols by the interaction of unsaturated aliphatic aldehydes or ketones containing more than 15 carbon atoms, with hydrogen in the presence of hydrogenation catalysts.

J. Y. Johnson. E.P. 399,258, 5.10.33. Manufacture of alcohols by equimolecular interaction of an alkylene oxide or an alkylene halogen hydrin with a metal compound of an aromatic hydrocarbon in the absence of Freidel-Crafts condensing agents.

Bat. Petr. Mij. E.P. 399,991, 19.10.33. Chlorination of paraffin and/or aromatic hydrocarbons by free chlorine in the dark at 0–30° C. is induced by simultaneously carrying out an addition process in the same reaction zone

between free chlorine and unsaturated hydrocarbons in the absence of substantial amounts of elementary oxygen.

Du Pont de Nemours. E.P. 400,297, 26.10.33. A process for the partial oxidation of gaseous unsaturated hydrocarbons for the production of olefine oxides, glycols, etc. The reaction is carried out in the gaseous phase at 250°–600° C. in a vessel having a surface-volume ratio of 4 : 1.

S. W. Ferris. U.S.P. 1,928,832, 3.10.33. White mineral oils are prepared from viscous (paraffin and naphthene) distillates by extraction with nitrobenzene. W. H. T.

1287. Patents on Refinery Plant. Foster Wheeler, Ltd. E.P. 398,099, 7.9.33.—Low pressure fractionating equipment consisting of a bubble-cap column, one of the lower trays taking the form of a gas-tight partition dividing the column into lower and upper sections. A pipe still discharges into the upper section, the heavier fractions which separate being fed into the lower section. Here, vaporisation is assisted by means of a steam jet from an ejector extending through the partition. S. B.

Bat. Petr. Mij. E.P. 399,441, 5.10.33. A heating system in which the heat transmitting medium consists of high boiling alkylated aromatic or naphthenic hydrocarbons which may have previously undergone hydrogenation.

C. D. Gard. U.S.P. 1,930,166, 10.10.33. Distillation equipment with means for preventing overloading of the column with vapours and reflux and for ensuring a constant quality of bottoms. Abnormal conditions are automatically adjusted, and the volume of vapours leaving the column and entering the reflux condenser is kept constant by regulating the heating in proportion to the volume.

E. C. D'Yarmett. U.S.P. 1,932,514, 31.10.33. A distillation unit employing film heating for rapid vaporisation without overheating. The evolved vapours are centrifuged so that heavier and lighter vapours may be removed separately.

C. L. Erickson. U.S.P. 1,932,655, 31.10.33. An easily cleaned and repaired mixing device for petroleum oil consisting of a number of interchangeable and readily removable sections adapted to be fitted in a normal pipe line. Treating agents are introduced into the centre of the stream.

E. F. Skinner. U.S.P. 1,932,712, 31.10.33. A furnace construction for use with cracking-plants.

W. G. Leamon. U.S.P. 1,933,020, 31.10.33. Apparatus for carrying on two independently controlled heating operations in a single heater having one fire box. W. H. T.

Class 700. Utilisation.

1288. Refinery Gas for City Supply. R. S. McBride. *Chem. Met. Eng.*, 1933, **40**, 508–511.—Use of by-product gas from a petroleum refinery as a regular part of city supply mixture has been accomplished under advantageous conditions in Brooklyn. The refinery gas used in this development is pumped about a mile at approx. 50 lb. pressure from the refinery to the gas works; it is either utilised directly or stored in two high pressure bullet holders, which float on the line. The heating value of this gas varies materially, averaging between 1750 and 1800 B.Th.U. per cu. ft.; sp. gr. is approx. unity. The method of use depends upon the quantity available:—

(1) All may be used merely for cold carburetting of blue water gas. So

used, 1 M. of refinery gas enriches about 6 M. of blue gas to the desired heating value.

(2) If the supply of cold carburetting gas is not sufficient to enrich all of the requisite water gas to the necessary heating value, some lightly carburetted water gas is produced.

(3) When there is more than sufficient for cold carburetting, some refinery gas is re-formed. This operation is carried out by passing the gas through the water gas generator with the steam both on the down-runs and the up-runs. The gas is cracked to give lighter hydrocarbons and free carbon, which is deposited on the fuel bed and becomes part of the solid fuel that is used during the blast and gas-making periods. Gas works procedure evolved to meet the variable city supply is discussed, and photographs and a flow sheet of the gas plants are given. G. R. N.

1289. Comparative Costs for Diesel Electric and Coal-fired Steam Power. W. A. Tookey. *Internal Comb. Engr.*, 1933, **1**, 3.—The relative advantages of different methods of power production can only be finally assessed in relation to the nature and individual requirements of each industrial undertaking. It is possible, however, to indicate the general lines upon which such an assessment should be made.

As an example of the method, this article makes a comparison between the costs for electrical units generated by coal-fired steam or Diesel power. The comparison is made for three factories requiring 100 k.w., 500 k.w. and 1500 k.w. In each instance the costs of working one, two and three shifts per day are given.

The details of the total costs in each case are tabulated and the final comparisons expressed graphically. The graphs indicate a marked saving in favour of the Diesel power, particularly with the smaller units.

G. B. M.

1290. Pressure Piping Effects on Fuel Injection. C. W. Lawson. *J.R. Ae.S.*, 1933, **37**, 694–702.—The author is of the opinion that one of the best ways to minimise the unfavourable weight/power ratio of the modern Diesel engine is by improving the efficiency of combustion, and the present article deals with experiments carried out with special apparatus to determine the effect of variables in the fuel injection system. The apparatus used is termed an injection meter, but the details of the instrument are not available, it being merely stated that the meter measures the quantity of oil delivered by a nozzle of the open or spring loaded type for every degree of pump shaft rotation during delivery. All experiments had to be made independently of the engine, the pump and meter being driven by electric motor, with a special coupling to ensure that the measurement of oil delivered might take place at the same point in each of a series of delivery cycles. A specially constructed open type nozzle was used, enabling various nozzle jets to be fitted quickly.

To check the repeatability of the readings, the same test was repeated six times, viz., plotting quantity of fuel delivered per degree of pump shaft rotation at speed of 600 r.p.m. and pipe length of 45.8 in. This test showed the results given by the apparatus to be constant within 4%, and the total fuel delivered checked up within 5% as checked by graduated measuring apparatus at low speeds, and a correction curve is given for pump speeds between 200–1000 r.p.m.

Curves showing the experimental results deal with the effects of varying speed, different pipe lengths, also the effects of these variables on dribble. Experiments were carried out also by varying positions of non-return valve,

readings being taken with pipe lengths of 45·8 in. and 89·3 in. and curves showing results are given.

The main conclusions drawn from results are as follows :—

The amount of dribble is influenced by : (1) The volume of the pipe. (2) The maximum pressure which is determined by pump speed and resistance through nozzle. (3) The position of non-return valve appears to direct flow of oil to one end or other of the pipe after pressure in pump is released.

The injection lag : (1) Depends to a small extent on pump speed. (2) Is proportional to pipe length. (3) Is found to bear some relation to the time taken by a sound wave to travel along the pipe.

The loaded injection valve is probably better for general purposes than the open nozzle. C. H. S.

1291. Running-in of Oil Engines. H. Shaw. *Oil Engine*, 1933, **1**, 172–173. —In this short article the author points out that the manufacturers of large engines cannot turn out machines specifying a "running-in" period in the same way as do motor-car engine builders. Large engines must be run-in in the works, and be capable of delivering maximum power output immediately on delivery. It is general practice, nowadays, to finish cylinders and bearings by grinding, honing, polishing or lapping. The author produces curves to show the beneficial effect of colloidal graphited oils for these purposes, and for the actual running-in. Reasons are given for effects observed when using colloidal graphite, and it is claimed that the expensive running-in periods and risks of seizure can be very much lessened by its use. C. H. S.

1292. Town Gas for High Speed I.C. Engines. C. M. Walter. *Trans. Inst. Min. Eng.*, 1933, **85**, 352–369.—In experiments carried out by the City of Birmingham Gas Department on the application of town gas for the running of high speed I.C. engines, it was found that 250 cu. ft. of town gas of calorific value 475 B.Th.U. per cu. ft. gross was equivalent to 1 gal. petrol for converted petrol engines, but the same volume of gas of lower calorific value could be used if the carburettor was replaced by a suitably designed air-gas mixer. Road tests were carried out on a vehicle fitted with a 20-h.p. engine having a compression ratio of 4·6. By employing a special design of air-gas mixer and by modifying the induction system the maximum power output for a C.R. of 4·6 was 92·8% of that obtainable from petrol. The C.R. was then increased to 5·6, with the result that a maximum power output at least equal to that obtainable from petrol was obtained. Under these conditions and with an ignition advance angle of 40° there was no detonation. The exhaust gases showed a complete absence of carbon monoxide under all running conditions. After 7000 miles running there was only a slight carbon deposit on the cylinder head. The gas was stored in bottles of alloy steel under a pressure of 3000 lb./sq. in., each bottle containing 352 cu. ft. It was fed from bottle to air-gas mixer by a two stage reducing valve, the second stage being from 5 lb./sq. in. to just below atm. pressure.

The problems of compressor plants for the gas, filling stations, and the use of town's gas as Diesel fuel were also discussed. G. R. N.

1293. Pulverised Coal. A Survey of its Possibilities as a Fuel for Internal-Combustion Engines. G. Staniland and G. W. Lee. *Auto. Engr.*, 1933, **23**, 358.—The chief difficulty to overcome is the presence of ash in the coal which has no counterpart in a fuel such as petrol. Although the washing of high-ash content coal is a common practice, this does not remove all the dirt and certainly does not remove inherent ash. If this difficulty can be

overcome, it is suggested that the way is then clear for the utilisation of pulverised coal in the internal-combustion engine. W. A. W.

1294. Low Cost Bituminous Road Surfaces. T. R. Patterson. *Contract J.*, 1933, **109**, 403.—This paper discusses results obtained with bituminous roads of the surface treatment, graded aggregate and macadam aggregate types, and explains how mistakes can be avoided in this class of work. A. O.

1295. Blister Formation in Floated Asphalt. Gaede. *Asphalt u. Teer*, 1933, **33**, 768–770.—The mechanism of the formation of blisters due to gas pressure caused by rise in temperature is discussed.

To avoid this trouble, the floated asphalt should be applied on completely dry concrete which has been coated with bitumen. Further precautions consist in: (1) using a sufficiently solid asphalt to withstand the probable temperature; (2) introducing a porous layer (sand or porous concrete) in contact with the outer air between the concrete and the asphalt; (3) using a porous concrete for the base. C. C.

1296. Asphalt Road Equipment. Anon. *Surveyor*, 1933, **84**, 229–231.—A symposium of papers presented at the Asphalt Paving Conference, New Orleans, December, 1932, briefly reviewing developments in the use of machinery for road construction purposes in the United States. A. O.

1297. Adhesion of Bituminous Binders and Stone. W. Riedel and H. Weber. *Asphalt u. Teer*, 1933, **33**, 677–680, 693–695, 713–718, 729–732, 749–757, 793–798, 810–812.—An extensive summary of the literature is given. The methods described there have the disadvantage that they take too long. That the mineral shall be better wetted by bitumen than by water is the first essential for good adhesivity. A new method is described for obtaining a measure of this property. Mineral of specified grading (passing 100 mesh/cm.^{2}—retained by 900 mesh/cm.^{2}) is stirred with hot bitumen (71% stone, 29% bitumen) and the mixture cooled. 0·5 g. is boiled with water 1 minute. If the bitumen leaves the stone, the latter is wetted more by water than by bitumen. The stones are thus divided into two groups, of good and bad adhesivity. Further differentiation can be made using soap solution (which has lower surface tension than water and therefore greater wetting power). The least concentration of soap which just causes separation is proportional to the wetting power and is a measure of adhesivity.

Stones of the same kind but from various sources showed different adhesive properties, but only small differences were found for different bitumens and tars on the same stone. The conclusion is reached that the cause of varying adhesivity must be sought in the properties of the minerals and not of the binders. The adhesion of tar may improve if tested some time after mixing. Adhesivity is independent of the proportions of the two constituents.

For testing emulsion-bitumen, stone is treated with excess emulsion, stirred, and after standing one hour the excess is poured off and the water evaporated. The stone/bitumen mixture is then treated as above. Breakdown of an emulsion is not directly connected with adhesivity. When the bitumen has greater wetting power than water, a complete skin may form over the stone, preventing any further specific action of the stone to cause breakdown. If, on the other hand, water has the greater wetting power, the bitumen will not form a continuous layer over the stone, and the latter can still exert a breaking action on the emulsion and a higher breakdown value may result. Adhesion will be good in the first case, but not in the second. The emulsifier adversely affects the adhesion test, since its action is added to that of the soap solution. As a result, the adhesion of bitumen from emulsion is worse than the same bitumen tested hot.

With cold tars, the flux oil, in general, has no appreciable effect on adhesion. The assertion that cold tars can be used with wet stone is disputed, for only with special stones can the tar displace water.

Bitumen-tar mixtures behave similarly to pure binders.

Tests are recorded on a series of flux oils. In general, oil behaves in the same way as binder, so that binder showing poor adhesion will not be improved by oil.

Further differentiation of stones can be obtained using sodium carbonate solutions, but the effect in this case is not due to surface tension, since the surface tension of soda solutions does not differ much from that of water, and is much higher than that of soap solutions. With soda, in contrast to soap solutions, the separation depends to some extent on the thickness of the coating. NaOH acts in a similar way to Na_2CO_3. Experiments were also carried out, using HCl and various neutral salts (sodium chloride, sulphate, citrate and potassium ferrocyanide). A relation exists between the adhesivity and the concentration of electrolytes required for separation, but the latter varies with different salts. The higher the valency of the anion, the smaller concentration of salt required to separate the bitumen. Salts with cations of higher valency are unsuitable for these experiments as they are weaker in action than NaCl.

Viscosity of the binder is unimportant unless such temperatures are reached that the binder becomes very fluid. Surface tension itself is insufficient to define wetting power (*e.f.*, oil and Na_2CO_3 solution); interfacial tension must also be considered. The roughness of the surface and porosity have no effect on wetting power. Washed stone behaves similarly to unwashed stone unless the dust, etc., possesses different wetting properties.

The hydrophilic (wetted by water) and hydrophobic (wetted by oil) characteristics are the essential factors in determining adhesivity. In practice, hydrophobic stone should be used for road construction, since there is a risk of damage by moisture with hydrophilic stones, although the danger is less if the bitumen is hard. C. C.

1298. Hard Floated Asphalt. P. Wichert. *Asphalt u. Teer*, 1933, **33**, 770–772.—The advantages of this material for road surfacing are discussed. It may be applied in winter or summer, and as soon as it is cold it is watertight. It should not be applied in layers more than 2–3 cm. thick. It is laid either on concrete or other even foundations or on a "binder" undercoat. The latter may be either bitumen-coated chips or a tar binder, and is necessary for uneven surfaces and where traffic is heavy. A recommended composition is as follows: Bitumen (40/50 K. & S.) 5·7%, Trinidad asphalt 3·8%, pulverised asphalt (6% bitumen content) 20·0%, lime-stone "flour" (40 per cent. finest "flour") 20·0%, fine sand 10·5%, hard stone chips (3/8 mm.) 40·0%. C. C.

1299. Bituminous Emulsions. E. Schneider. *Bitumen*, 1933, **3**, 167–172.—A summary of the various applications of bituminous emulsions in road-making. C. C.

1300. Protective Paints for Metals. U. R. Evans and S. C. Britton. *Chem. Trade J.*, 1933, **93**, 299.—In a paper presented to the 64th general meeting of the American Electrochemical Society at Chicago in September, 1933, the authors described their recent investigations at Cambridge on the factors underlying the protection of metal surfaces by paints. The protective quality of paint does not depend on its imperviousness but on the presence, in the lowest coat, of some substance which chemically inhibits corrosion. The lowest coat should be chosen for its chemical properties, and the upper

coat for its mechanical properties, as in the well known combination of red lead and iron oxide coats. Among the best inhibitors are powders which are not suitable pigments, but litharge and magnesia are effective in preventing rusting. Mechanical failure of the coating may result from rusting of the metal, or the coating may first fail, exposing the iron to rusting. Frost has not been found to cause failure, except where rust had already began to form under the coat.

The results of the authors' tests indicate the superiority of copper steel over ordinary steel, and the good behaviour of wrought iron which forms two scales, one which comes off very easily and the other is so adherent that it is quite safe to paint over it without descaling. The mill scale on steel depends on rolling conditions. In general descaled steel painted over shows rust stains earlier than unscaled steel, but the coat adheres better. In the unscaled steel attack takes place at cut edges or breaks in the scale, and this slowly spreads under the scale, causing it and the paint to flake off together. The work carried out on methods of descaling does not support the suggestion that pickling leaves traces of water or acid on the metal which cause failure. Rust should always be removed as far as possible by vigorous wire brushing before painting, as its danger lies in its imperfect adhesion, its power of absorbing moisture and possibly its content of electrolyte.

The invisible moisture film present on bright steel when painted before dawn caused premature failure as compared with similar specimens painted dry in the afternoon. Drops of NaCl solution evaporated on bright steel before painting also caused failure of the surface, suggesting that trouble attributed to faulty pickling may be due to the osmotic suction of included salts. Chromates appear to be excellent pigments for the undercoat, but may fail when the rain is acid. Mixtures of chromates and basic oxides, *e.g.*, zinc oxide, are therefore being tested. Graphite may stimulate corrosion electrochemically in the lower coat, but is of value in the outercoat. Metallic zinc paint as primer offers electrochemical protection; in practice zinc oxide mixed with the metal is to be preferred.

In an examination of a number of drying oils, the deleterious effect of foots in iron oxide paints was marked, while red lead paints were little affected. Almost any of the other oils examined gave rust inhibitive paints (with suitable pigments), and could be used with a widely varying proportion of pigment without affecting the protective value. It is felt, however, that in many commercial ready-made paints the pigment content is too low.

With red lead pigments, considerable latitude in the amount of thinner is possible, except where the part is so thin that the pigment clots, leaving clear oil in between. With iron oxide paints the protective value falls off steadily as the thinner content is increased (since iron oxide in distinction to red lead depends for its value on mechanical protection against corrosive influences).

A paint rich in drier undergoes slow after-changes and tends to perish, and if rain falls on the coat before it is dry a failure is very rapid. The degree of protection in wet weather increases with the drier content, and in dry weather it decreases steadily with the drier content. Thus in dry climates the drier should be reduced to the minimum, but in wet climates or doubtful weather it should be added freely. C. L. G.

1301. Oil Consumption in Motor Car Engines. W. H. Graves. *A.S.T.M. Symposium on Motor Lubs.*, 1933, 85–100.—Oil consumption as related to actual consumption in the engine is dependent upon three main factors: (1) Engine speed; (2) engine design and changes due to wear; (3) oil characteristics.

(1) *Engine Speed.*—Tables are given to show the effect of engine speed on consumption, and there is agreement amongst different investigators to show that it is a fact that oil consumption increases rapidly with increase in engine speed.

(2) *Engine Design.*—Round points out that oil consumption which is due to the amount of oil passing an engine piston depends upon the following: (*a*) Number of piston strokes; (*b*) the oil viscosity and character; (*c*) amount of oil thrown to the cylinders; (*d*) the ring fit; (*e*) the vacuum in the cylinder. Other important influences are: (*f*) Crankcase oil temperature; (*g*) cylinder wall temperature; (*h*) return of oil from cylinder wall.

A graph is given to show that with a recently designed engine working under controlled conditions: (1) Oil consumption decreases with increased mileage and then increases; (2) smaller crankshaft metering reduces oil consumption somewhat; (3) changing the location of bleed-holes in connecting rods in an engine may increase or decrease oil consumption depending upon the amount of oil thrown on the cylinder walls; (4) ring grooves fill with carbon and this increases oil consumption, cleaning them reduces oil consumption; (5) a properly lubricated and clean engine may give decreased oil consumption up to 18,000 or 20,000 miles at which oil consumption increases.

Results of recent tests made on changes in engine design are: (1) Piston rings of the same design but of different manufacture may show up a difference of 100% in oil consumption; (2) with a large excess of oil on the cylinder walls the deeper or larger the oil ring groove the less is the oil consumption; (3) the more oil thrown on the cylinder walls the greater the oil consumption; (4) limited change in water outlet temperature and oil temperature at pump outlet only slightly affects oil consumption; (5) change in oil pressure if it changes quality of oil thrown on cylinder walls has an appreciable influence on oil consumption.

(3) *Oil Characteristics.*—Data are given to show conclusively that as viscosity of lubricant increases, the oil consumption decreases up to a critical viscosity, after which oil consumption increases with increase in that property. Work by various investigators demonstrates that volatility has an important bearing on oil consumption. Livingstone and Gruse state that oils should be non-volatile at cylinder wall temperature below the combustion chamber but volatile at cylinder wall and head temperature in the combustion area. Thus volatility of an oil should be defined in terms of engines and operating conditions rather than by arbitrary laboratory test. Haslam and Bauer show that with increased volatility there is increased oil consumption.

R. E. D.

1302. Factors in Engine Design which Affect Oil Performance. A. L. Clayden. *A.S.T.M. Symposium on Motor Lubs.*, 1933, 101–109.—The purpose of this paper is to review what might be done on engine design in general which would have the effect of lessening the burden now placed upon the lubricant. This is discussed under the headings oil wastage, bearing lubrication and oil deterioration. With regard to oil wastage: the pistons of an I.C. engine are invariably supplied with many times the necessary volume of lubricant, and this accounts for most of the shrinkage in volume of the oil in the engine. A variety of devices have been tried with the object of reduction in volume of oil fed to the pistons. Certain combinations of gasoline-engine pistons and oils are prone to ring-sticking which is sometimes curable by increasing the oil supply and therefore increasing the direct wastage. Since, however, ring-sticking never occurs, except when the oil used is manifestly unsuitable, it is safe to say that a very large reduction in oil wastage would be possible

if complete control over the supply were obtained. The excessive supply is also due to the nature of the crankcase atmosphere, and the ideal is either to isolate the cylinders from the crankcase or to change the nature of the crankcase atmosphere, the latter being the only practical possibility. Oil wastage is also raised by increase of speed and may vary very considerably according to the design of engine with particular reference to ends of bearings and connecting rod bearings. With regard to bearing lubrication, the author has little to add to the information given in the Symposium on Bearings held by the S.A.E. With regard to oil deterioration, the same serious effect is due to contamination by abrasives. Abrasives enter almost entirely with the air for combustion and are transferred to the main body of oil past the pistons. The author considers that most "air cleaners" which have been designed to overcome this are of little value since there is no noticeable improvement in the life of piston rings and cylinder walls. The author also places oil filters in the same category, though a certain amount of benefit is derived since they trap out fairly large quantities of sludge which also contains abrasive dirt. Contamination with fuel is of minor importance, since it can be practically eliminated by careful control of engine conditions. Leakage of products of combustion into the crankcase is a major source of deterioration. Crankcase sludges originate from this leakage since the two necessary ingredients —water and carbon—are thus supplied. This deleterious effect will probably be minimised by a combination of automatic control of the oil temperature, crankcase ventilation and provision of means to insure a steady flow of oil through such parts of the engine that attain high temperatures. G. R. N.

1303. Aircraft Engine Lubrication. A. Nutt. *A.S.T.M. Symposium on Motor Lubs.*, 1933, 114–121.—The use of available oils in aircraft engines is discussed. The selection of oils is based on operating experience, on the basis of which attempts have been made to prepare purchasing specifications. Oils passing such specifications have on occasion proved unsuitable in use.

The oil should prevent undue wear of parts, have as flat a viscosity curve as possible and should not form sludge. A low pour test is desirable for cold weather operations.

From the aspect of sludge formation, mineral oils are superior to vegetable, as many engines operating on the former may run as much as 500 hours without top overhaul, whilst with the latter overhaul is frequently required at 100 hours or less. In U.S.A. little or no vegetable oil is used.

In aircraft engines it is desirable to keep oil consumption between 0·010 and 0·020 lb./b.h.p. hour. Oil consumption is a function of speed, bore of engine, relative size of this bore to the centre distance between cylinders, oil flow through engine, jacket or cylinder temperature and the oil temperature.

The control of oil temperature is of significance in operation. The oil going into the engine should not exceed 85° C./185° F., when using oil of 120 Saybolt sec. viscosity at 210° F. The use of a system where oil lines and tank are insulated and all cooling done in the oil cooler is favoured by the author. Under sub-zero conditions a lighter oil is necessary.

In aircraft engines which normally operate at 75% power and over, the oil serves both for lubrication and cooling. The oil flow through the engine must ensure satisfactory piston cooling and absence of undue wear.

Oils suitable for use at higher cylinder temperatures are desirable and will justify an increase in price. B. C. A.

1304. Extreme Pressure Lubricants. W. T. Sieber. *Petr. Eng.*, Sept., 1933, **4** (8), 22.—The use of E.P. lubricants has become necessary since the introduction of hypoid and worm-gear drives for modern automobile trans-

mission. The evolution of special methods of test and of special lubricants is outlined. There are three main types of oil: (1) Petroleum oil blended with a saponifiable oil that has been treated with sulphur chloride; (2) petroleum oil blended with a saponifiable oil to which elementary sulphur has been added; (3) lead soap lubricants to which sulphur has been added or in which sulphur occurs native in the petroleum oil used. Fatty oils of mineral origin are generally used but vegetable oils may be employed. In sulphurising these fatty compounds great care must be exercised in order to combine the sulphur or chlorine in the right way, in order to obtain maximum pressure stability with minimum corrosion. This is fairly simple to accomplish with the use of sulphur chloride, provided the finished compound is freed from HCl formed during the reaction. Owing to difficulties in handling, however, few manufacturers use sulphur chloride. Saponifiable oils are generally sulphurized with the aid of flowers of sulphur at high temperatures, the process requiring considerable time and care. Efficient ventilation is necessary to remove the large quantities of H_2S liberated.

One factor of importance in the manufacture of lead soap lubricants is the necessity to incorporate the soaps with mineral oil at a temperature of approximately 400° F. in order to obtain maximum pressure stability. Many varieties of petroleum oil are used, but it is essential to employ a well refined oil in order to avoid undue increase in viscosity and consistency of the lubricant owing to oxidation. R. A. E.

1305. Carbon Deposits in Gasoline Engines. W. A. Gruse. *A.S.T.M. Symposium on Motor Lubs.*, 1933, 7–26.—The paper is a review of some of the available data on the formation of so-called carbon deposits in gasoline engines. The more important factors governing this problem are:—

(1) *Engine running conditions, temperature, speed and load.*—Deposits accumulate rapidly at low engine temperatures, and when the temperature is raised the deposit is reduced.

(2) *Oil Consumption.*—Deposits vary in amount with oil-consumption and correlation is possible only when the amount of carbon deposited per volume of oil consumed is considered. Occasional cases occur in which excessive oil supply resulted in lower deposits.

(3) *Time since cleaning.*—In general, deposits increase with time, but only up to a certain point, which may be regarded as a carbon tolerance or equilibrium for each engine. Some oils, however, show no apparent tendency to reach an equilibrium in the exhaust ports of individual cylinders of sleeve valve engines, the ports eventually being completely blocked.

(4) *Amount of dust in air.*—In exceptional cases, a deposit will contain 30 to 40% of inorganic matter.

(5) *Air-fuel mixture ratio.*—Paraffinic, mixed-base and naphthenic oils deposit roughly twice as much carbon with a 10 : 1 air-fuel ratio (365° F. head temp.) as they give with a 12 : 1 ratio (400° F. head temp.).

(6) *Engine design and conditions.*—These factors do not lend themselves to discussion.

(7) *Characteristics of fuel.*—Changes in fuel volatility do not apparently influence carbon deposition until the fuels become sufficiently high boiling to produce poor carburetion. Fuels exert an influence in respect of their gum contents; high intake-temperatures (175° F.) cause deposition of the gum, mainly in the manifold; with unheated intake there is a small increase in the engine carbon deposit. As marketed gasolines seldom contain over 10 to 12 mgrs. preformed gum per 100 mls., there is little possible effect on carbon deposition to be expected from this cause.

(8) *Characteristics of the oil.*—Stress is placed on the volatility properties of oils—the author being of the opinion that normally there is little oxidation.

An over-ventilated crankcase shows up sludging trouble, but this is mostly caused by water leaking from the cylinder block. Carbon formation from oil is said to depend on : (*a*) The amount of residue not volatile at the prevailing temperature ; (*b*) amount of coke formed from this residue ; (*c*) degree of adherence of this coke.

(9) *Carbon deposits and coking tests.*—Attempts to correlate actual engine deposits with oxidation tests have not been successful. Crankcase oxidation might have significance in piston-ring sticking at high jacket temperatures. Stress is placed on carbon residue determinations mainly because they are rough measures of volatility. Considered alongside each other, coking tests and volatility tests seem to be highly significant. C. I. K.

1306. Expanding Market for Liquefied Gases Through Use of Disinfecting Torch. *Oil & Gas J.*, 14.9.33, **32** (17), 29.—To expand the market for liquefied petroleum gases, a burner and auxiliary equipment has been developed to enable the poultryman to rid premises of destructive bacteria. The use of chemical disinfectants is attended by certain disadvantages, *e.g.*, tainting of food and water, and they are not always effective. The germ which causes coccidiosis in poultry is greatly dreaded and is highly resistant to chemical disinfectants. It is, however, readily destroyed by heat, a temperature of 170° F. being effective in three seconds. It is claimed that large reduction in chicken mortality has been achieved when kerosine and gasoline torches have been consistently used in the past, but the new torch employing liquefied gases is stated to be more economical and efficient. The maximum flame temperature is 2000° F., but provided reasonable care is exercised there is no danger of fire, and many insurance companies permit the use of such torches without increase in insurance rates. Frequency of torching depends on seasonal changes and habits of the different breeds of fowls, but it is suggested that the operation should be performed after every cleaning and removal of litter. In cases where disease has broken out in the flock, torching should be carried on daily. Other uses are indicated.
R. A. E.

1307. Spray Fluids, VI. R. M. Woodman. *J.S.C.I.*, 1933, **52**, 351T–352T.—This paper deals with the effect of varying proportions of water and aid-to-dissolution on miscible oil formation, and on the character of the emulsions subsequently formed from these miscible oils. It has been previously shown that the most important ternary system in a miscible oil system is that containing the aid-to-dissolution, emulsifier and water. In the example taken, a ternary solution is selected in the isotropic soap phase of optimum composition for incorporating toxic oil. Emulsions with toluene, benzene, dekalin and tetralin are described. Addition of a certain amount of excess water before mixing the toxic oil does not appreciably influence the stable and non-creaming characteristics of the oil-in-water emulsions formed by subsequent addition of water in bulk, but additions of aid-to-dissolution (phenol) before incorporating the toxic oil gives instability and rapid creaming. There appears to be no reason why turbid miscible oils should not form good spraying emulsions. C. C.

1308. Spray Fluids, VII. R. M. Woodman and H. R. Barnell. *J.S.C.I.*, 1933, **52**, 352T–353T.—Experiments are described from which it is concluded that the effect of gelatin in the spray fluid on water losses from the foliage is practically negligible, and there should be no danger of clogging the stomata.
C. C.

1309. Lubricants for Metal Working. *Chem. Trade J.*, 1933, **93**, 211.—Lubrication of machinery used in metal working presents a number of difficulties, not the least being the corrosive action of many lubricants hitherto used. These were mainly fatty oils, but they have now been largely replaced by preparations having a mineral oil base, to which mineral matter, soap, etc., are added. Mineralized colza is probably one of the best in the fatty oil class. Sulphurized mineral oils and lead soap mixtures have lately been introduced for metal drawing. A wide variety of recipes now available contain varying proportions of some of the following ingredients: French chalk, methylated spirits, powdered lithopone, sulphur, oleic acid, caustic soda, machine oil, water, paraffin and soft soap. The use of ordinary machine oils and cutting oils is not recommended. Systematic research is being carried out by leading manufacturers of proprietary brands of lubricants with a view to finding the best lubricant for the different kinds of metal working and the varieties of metal or alloy to be dealt with. R. A. E.

1310. Comparison of Methanol and Other Anti-Freeze Agents. T. C. Albin. *Chem. Met. Eng.*, 1933, **40**, 526–527.—The Wood Chemical Institute Inc. propose the following specification for anti-freeze methanol: (1) Grade, not less than 97%; (2) colour, water white; (3) miscibility, in all proportions with water without turbidity; (4) acetone, not more than 2% by vol.; (5) esters, not more than 0·5% (as methyl acetate); (6) allyl, not less than 80 ml. as determined by bromine absorption; (7) analysis to be according to methods prepared by the Bureau of Industrial Alcohol for denaturing-grade methanol. The author shows by the aid of graphs that for all concentrations up to that giving about −25° F. as a freezing point, the vapour concentration of methanol is less than that of ethyl alcohol for a given amount of protection, water being the diluent. With concentrations below that affording −5° F. freezing point the actual boiling point of the methyl alcohol-water is higher than ethyl alcohol-water. At greater concentrations the ethyl alcohol-water has the higher boiling point. G. R. N.

1311. Bricks from Oil Shale Refuse. *Chem. Trade J.*, 20.10.33, **93**, 286.—Oil shale refuse in Mid and West Lothian has in the past been used to make bricks, but it was found that they did not stand up to weather sufficiently well to make the venture a commercial success. A method has now been found of eliminating the earlier faults and of producing a brick which will withstand Scottish weather conditions. An oil company is now preparing to manufacture bricks at Pumpherston Works, Mid Calder. C. L. G.

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